Canadian Industry Program for Energy Conservation

1990

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CANADIAN
INDUSTRY PROGRAM
FOR ENERGY CONSERVATION

PROGRAMME CANADIEN
D'ÉCONOMIE D'ÉNERGIE
INDUSTRIELLE

October 30, 1991

The Honourable Jake Epp, P.C., M.P.
Minister of Energy, Mines and Resources
House of Commons
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Dear Minister,

The 1990 energy performance of CIPEC reporting companies was significantly affected by low production volumes and capacity utilization. As a result, energy use per unit-of-output deteriorated by 2.7% in 1990 as compared to 1989. It is also the principal reason why CIPEC has fallen short of the 1990 target of 31% improvement over the 1973 reference base year.

Despite this disappointing performance, energy utilization in 1990 has improved by 26.2% since the 1973 reference year.

Canada and Canadian industry are energy intensive, and the reasons for this are very complex. Our energy use is now being considered, along with that of every other major energy user, in the context of the global warming issue. The CIPEC program, with its unique capabilities and performance monitoring procedure, provides a significant benefit in assessing this energy use. It will also help to deliver Canada's required contribution to evolving environmental objectives.

The "energy environment" is very different from what it was when the CIPEC program began 16 years ago. The need for conservation has been intensified, not only by the global warming problem, but also by the concerns for industries' productivity and competitiveness in world markets. It is now even more important that industry and government maintain and develop the cooperative CIPEC relationship.

We look forward to renewed success.

Sincerely,

W Peter Torbet

W. Peter Torbet
Chairman
CIPEC Council

The Canadian Industry Program for Energy Conservation (CIPEC) is an industry-administered/government-sponsored program for promoting and monitoring energy efficiency throughout the Canadian manufacturing and mining industries.

CIPEC was established on May 23, 1975, as a result of deliberations between the Federal Government Ministers of Energy, Mines and Resources and Trade and Commerce, and 50 of industry's most senior representatives. It now consists of 14 different industrial task forces that represent a broad spectrum of Canadian manufacturing and mining industries.

The program's objectives in promoting energy conservation are to:

- Promote energy productivity improvement in Canadian industry;
- Maintain an effective forum for industry/government dialogue on energy utilization and productivity matters;
- Forecast aggregate energy productivity improvement based on Canadian industry programs;
- Collect data and report on energy productivity of Canadian industry.

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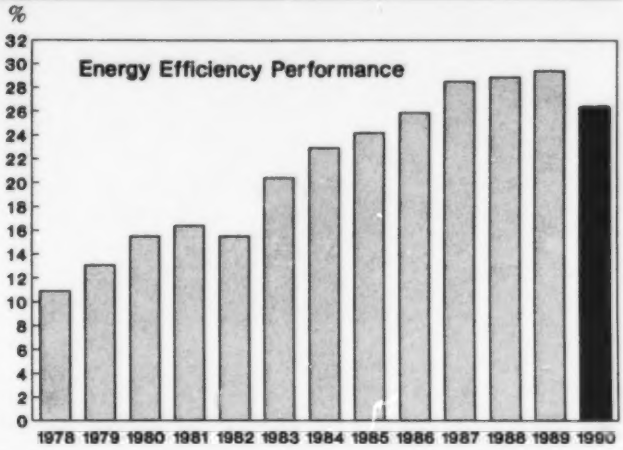
CIPEC Consolidated Performance 1990



Industrial energy use efficiency declined 2.7% during the year but is still 26.1% better than it was in the 1973 reference year. The 1990 performance thus fell short of the 31% target figure that was set five years ago. The performance of each participating sector is shown in Figure 2.

Energy use efficiency in this annual report is defined as the rate of change in energy utilization over a specified period of time. Energy consumption per unit of production (energy intensity) is the basic trend that is monitored. This production-based method readily provides the kind of technical information that is used by participants to compare energy intensities and performance trends.

The results in this survey come from 565 of the largest manufacturing and mining companies in Canada representing approximately 70% of the energy used by all of industry. Thirteen of the most energy-intensive industry sectors are included in this annual survey.

The widespread 1989-90 general economic recession was the main reason for this year's decline in industrial energy utilization. While the general economy's GDP at factor cost fell 1.7% below December 1989's, the goods-producing industries, which felt most of the impact, fell 10% below the May 1989 peak. In the manufacturing sector, transportation equipment, wood and plastics industries were the most affected. Economic losses in the mining group were concentrated mostly in the coal, potash and nickel mining sectors which are monitored by CIPEC.

As a result of depressed business and lower production volumes, plant and factory capacity utilization in the total manufacturing sector decreased from 80% to 74% during the year. This Statistics Canada measurement, however, does not account for the numerous plants that were shut down because of obsolescence or relocated to the U.S. or Mexico. The durable-goods sector ended the year with only 71.1% of its production capability being utilized.

The non-durables sector was somewhat less affected with a decline from 83.7% to 77.1%. In the mining industry, several gold producing companies reported operating at only half of their capacity levels.

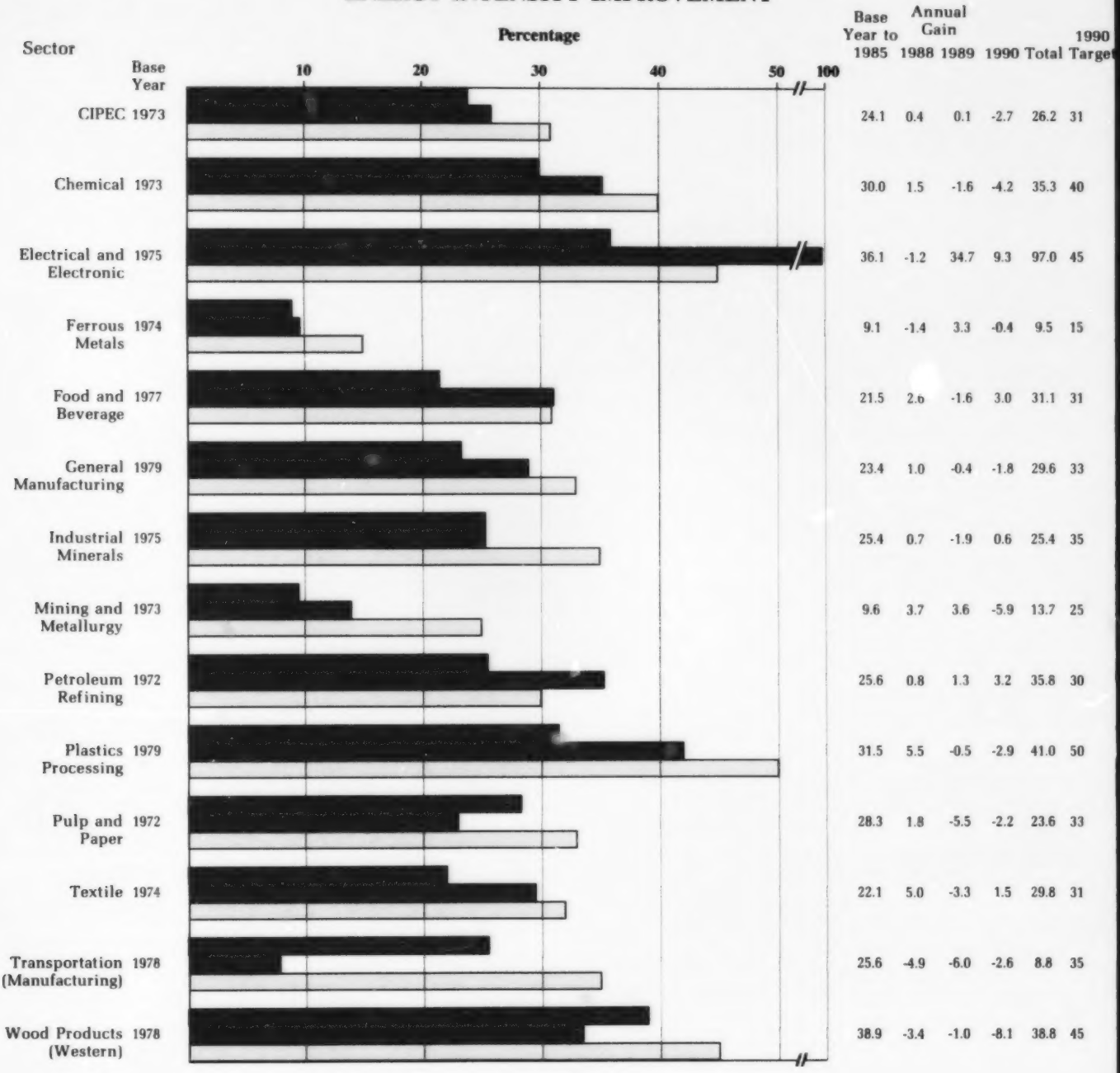
During the past decade, significant changes in industry's operating environment have had a substantial impact on energy utilization. The most universal of these are: the impact of two economic recessions; the profound effects of the Canada-U.S. Free Trade Agreement; widespread restructuring and downsizing strategies designed to meet intensified competition; reduced technical capabilities caused by leaner staffing; deregulation of natural gas contracts that lowered fuel prices and reduced energy conservation momentum; and high interest rates which slowed investment in new projects and retrofits. Individual sectors and their member companies could contribute many other factors to this list.

What's more, these changes have accelerated in the past 5 years to widen the gap between the real and anticipated operating scenario.

The average rate of improvement since the 1973 base year is 1.5% per year. Performance was good prior to the 1982 recession when programs were stimulated by the potential of energy shortages and rapidly escalating prices. During the 1982 recession, energy efficiency fell about 1% when companies

Figure 1

ENERGY INTENSITY IMPROVEMENT



Sector	Base Year	Base Year to 1985	Annual Gain 1988	1989	1990	Total	1990 Target
CIPEC	1973	24.1	0.4	0.1	-2.7	26.2	31
Chemical	1973	30.0	1.5	-1.6	-4.2	35.3	40
Electrical and Electronic	1975	36.1	-1.2	34.7	9.3	97.0	45
Ferrous Metals	1974	9.1	-1.4	3.3	-0.4	9.5	15
Food and Beverage	1977	21.5	2.6	-1.6	3.0	31.1	31
General Manufacturing	1979	23.4	1.0	-0.4	-1.8	29.6	33
Industrial Minerals	1975	25.4	0.7	-1.9	0.6	25.4	35
Mining and Metallurgy	1973	9.6	3.7	3.6	-5.9	13.7	25
Petroleum Refining	1972	25.6	0.8	1.3	3.2	35.8	30
Plastics Processing	1979	31.5	5.5	-0.5	-2.9	41.0	50
Pulp and Paper	1972	28.3	1.8	-5.5	-2.2	23.6	33
Textile	1974	22.1	5.0	-3.3	1.5	29.8	31
Transportation (Manufacturing)	1978	25.6	-4.9	-6.0	-2.6	8.8	35
Wood Products (Western)	1978	38.9	-3.4	-1.0	-8.1	38.8	45

Legend: ■ – 1985 Total Improvement
□ – 1990 Total Improvement
□ – 1990 Goal

Source: CIPEC Task Force Reports

trimmed production to reduce inventory levels and reorganized to launch the necessary new productivity efforts. The recovery years between 1983 and 1987 saw energy efficiency increasing by 2% per year. The flat performance during 1988 and 1989 was a preview of the 1990 decline.

Closer assessment of the linkage between energy efficiency and the key factors of production volumes and capacity utilization reveals that about two-thirds of the gain is due to changes in production volumes. In this sense, the results, although real, can be thought of as being somewhat "soft". In addition, changes in capacity utilization have a similar affect on efficiency. Since capacity utilization has slipped from 86% in 1973 to 79.6% in 1990, it has had a negative impact on energy efficiency throughout most of the CIPEC monitoring period. As a result, only one-third of the net improvements have come from tangible energy conservation actions such as retrofits, process enhancements, better housekeeping and maintenance, redesign of products, etc.

Some fluctuations in energy utilization will inevitably result from variations in production and capacity levels. However, a major effort is necessary to strengthen the consistency and source of sustainable energy utilization to insure that maximum cost savings and control of environmental emissions are achieved.

Many progressive companies have already recognized this need as a result of their "strategic site assessments" and combined energy-environmental audits. In these cases, steps are being taken to redesign processes to be more flexible, while at the same time operating at peak efficiencies. The traditional design philosophy of using single oversized pieces of equipment is giving way to down-sizing and compartmentalizing techniques. Installation of variable speed drives, demand controllers, etc., is now considered essential in new designs.

Routine energy management, according to the surveys, is also showing signs of renewal. For example, some companies are reactivating energy conservation committees. Energy accounting and performance monitoring systems are being computerized to a greater extent. Companies are again expressing the need for up-to-date information and proven energy conservation techniques.

1990's negative efficiency trend is therefore thought to be a low point in the history of the CIPEC program.

Surveyed Energy Consumption

The 1,430 petajoules (PJ) of energy surveyed by CIPEC represents 70% of the total 2,044 PJ used in the industrial sector in 1990.

One PJ of energy is equivalent to 277 million (net) kWh, 26.8 million m^3 of natural gas, or 25,641 m^3 of distilled fuel oil.

Industry used 32% of the total domestic energy demand in 1990; down from the 37.6% peak level in 1988 and traditional usage of 35% in the middle 1980s. The reduced 1990 consumption share is equal to the percentage of total domestic demand reported during the 1982 recession. Notwithstanding some recovery following the current recession, it is expected industry's proportion will not rise much because of the fundamental structural economic changes now taking place. Industry is down-sizing relative to other sectors of the economy.

This annual CIPEC efficiency survey does not include all sectors defined by Statistics Canada as manufacturing and mining. For instance, construction, oil drilling, secondary textile and clothing, furniture, and other small miscellaneous industries are not surveyed because of their low energy intensities and

Table I

Consolidated Energy Consumption

Type	Quantity	Terajoules	Percentage
Natural Gas m^3	3,265,808,947	494,030	34.5
Electricity* MWhr	74,414,567	291,634	20.4
Liquid Petroleum:			
Light Oil m^3	282,705	11,208	.8
Heavy Oil m^3	3,716,745	155,558	10.8
Diesel m^3	369,276	14,681	1.0
Gasoline m^3	25,530	922	.1
Coal tonne	1,714,517	55,036	3.8
Coke tonne	3,763,648	87,693	6.1
Petroleum Coke tonne	2,584,334	60,215	4.2
Steam	n\a	23,366	1.6
LPGs tonne			
Other Fuels	n\a	211,120	14.7
Totals		1,430,238	

*All sectors' electricity converted at 3.6 MJ/kWhr.

marginal energy costs. The eastern wood industry, pharmaceutical, industrial machinery and farm equipment manufacturing sectors no longer participate in the surveys for much the same reason.

CIPEC trends show conditions in the largest, energy-intensive, processing type operations. Compared with the broader base of manufacturing companies in the Statistics Canada database, CIPEC surveys display a number of important differences. For example, CIPEC surveys focus on real (non-economic) operating and efficiency trends and gather information on use of waste fuels. Although the proportions of energy used are somewhat different than published by StatsCan, comparison of overall data is, nevertheless, still valid.

Figure 2

Domestic Energy Consumption Trends

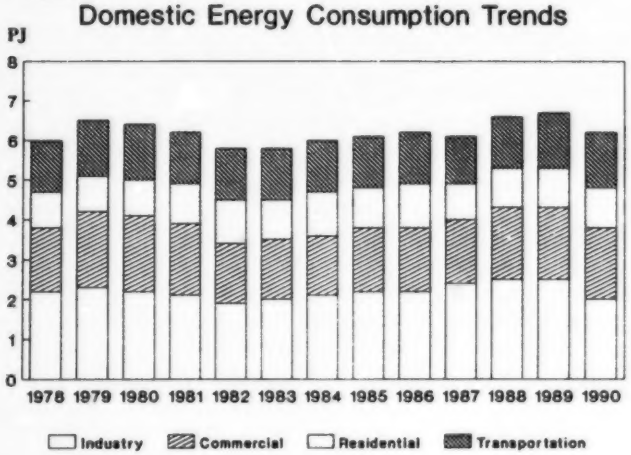
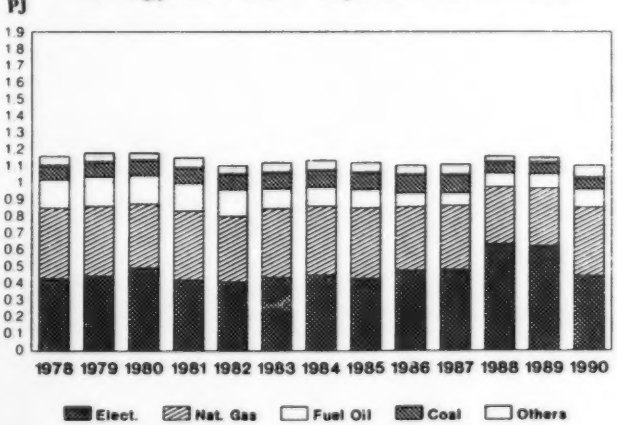


Figure 3

Energy Use Consumption and Trends



Energy Use Trends

The proportions of CIPEC surveyed energy consumption have changed each year since monitoring began in 1978 because of:

- changes in the reporting population
- shifts in industry composition
- effects of government and utility substitution programs, price and contract incentives
- changes in process technology
- restrictions in deliverability of fuels
- installation of cogeneration facilities
- impact of weather patterns
- preference for secure sources
- environmental benefits

Table II shows the sector trends while the graphic on page 1 shows the CIPEC composite trends since monitoring began in 1978.

Electricity

CIPEC participants used 76,414 GWh of purchased electricity in 1990 which is 42% of the total reported by Statistics Canada (SC 57-003). Additional power cogenerated by CIPEC firms is not identified although the fuel used for this purpose is included in other categories. The extent of monitored electrical coverage in the energy intensive industries ranges from 82% in the highly concentrated petroleum refining sector down to 37% in the diverse and scattered mining group.

Electricity provides 20.4% of the total power in the CIPEC group of companies with the highest percentage used by wood products (52%) and the lowest (5%) in the petroleum refining sector which self-generates much of its own electrical power. StatsCan reports a composite figure of 32% for all of industry, which includes a higher proportion of electrical use in small companies.

The trend to greater use of electricity consumption appears to have peaked at 30.1% in 1987 and is now in decline throughout the CIPEC group. Escalating prices, reduced production demand in the electricity-intensive sectors and utilities' switch from consumption incentives to promotion of conservation appears to be having an effect on this demand. The most noticeable change is in Quebec where Hydro

Table II

Distribution of Energy Consumption (percentage)

	Electricity			Natural Gas			Liquid Pet. Products			Coal & Coke			Steam			Others		
	'90	'85	'80	'90	'85	'80	'90	'85	'80	'90	'85	'80	'90	'85	'80	'90	'85	'80
Chemicals	10.8	9.5	8.3	52.1	56.2	54.4	2.0	7.3	19.1	0.4	0.1	2.3	2.2	2.0	1.0	22.5	25.2	15.0
Electrical & Elect.	38.2	33.5	31.5	58.0	63.6	57.3	1.6	1.4	9.5	-	-	-	1.8	1.5	-	-	1.5	-
Ferrous Metals	7.9	7.3	5.9	11.9	19.4	18.9	8.3	4.2	10.5	71.9	69.1	64.6	-	-	-	-	-	-
Food & Beverage	20.6	18.6	14.6	63.2	69.7	64.8	16.2	11.7	20.6	-	-	-	-	0.3	0.3	-	-	-
General Mfg.	34.2	28.1	26.1	53.7	60.2	52.9	11.4	11.5	21.0	-	-	-	0.1	-	0.1	-	0.1	-
Industrial Minerals	18.2	15.6	15.8	40.6	42.6	43.1	8.0	8.7	26.1	31.4	32.4	14.3	1.8	0.5	0.6	-	0.7	0.1
Mining & Metallurgy	34.1	41.2	39.5	16.2	25.2	18.6	32.0	23.5	36.5	9.5	9.9	4.5	8.2	n/a	n/a	-	0.2	0.5
Petroleum Refining	5.0	4.5	3.6	15.8	22.3	12.5	57.3	6.7	23.7	20.9	19.6	15.1	1.0	2.5	-	-	44.7	44.7
Plastics Processing	43.6	43.2	33.4	54.5	51.4	63.5	1.9	5.4	3.1	-	-	-	-	-	-	-	-	-
Pulp & Paper	36.8	44.9	29.1	31.8	26.1	25.5	30.1	25.8	41.3	1.3	2.9	3.0	-	-	-	-	0.3	1.0
Textiles	29.5	29.1	22.0	56.3	55.0	27.2	14.2	15.8	49.1	-	-	-	-	-	-	-	0.1	1.7
Transportation (Mfg.)	33.7	30.1	23.6	54.8	55.2	49.5	2.8	3.7	16.2	8.7	11.0	11.1	-	-	-	-	0.6	-
Wood Products	52.5	48.0	43.6	47.5	52.0	45.3	0.0	-	11.1	-	-	-	-	-	-	-	-	-
CIPEC Totals	20.4	19.1	18.5	34.5	32.3	31.0	16.4	17.6	24.3	13.3	19.2	17.1	1.5	1.0	1.0	13.8	11.8	9.1

Quebec has cancelled consumption incentive contracts. Ontario Hydro is now promoting use of alternate fuels to replace electricity.

The estimated cost of $3.9 billion for electricity constituted 51% of the overall energy expense in the surveyed companies during 1990.

The average rate paid by CIPEC companies was about 5.1 cents per kWh, although there is considerable variance because of different rate structures. In Ontario, where nearly 60% of electricity is generated by nuclear plants, the average industrial rate is 5.3 cents per kWh. Manufacturers in British Columbia, Manitoba and Quebec, with a high percentage of hydraulic generation, enjoyed the lowest rates at 3.6 cents per kWh.

Canada-wide electrical cost rates have escalated 4.5% per year since 1985. Ontario Hydro rates will jump by 11.8% in 1991 while Quebec rates are scheduled to increase 14.5% in the next two years. Manufacturers in other provinces will likely see similar price increases as utilities factor in their escalating costs.

Electricity consumption has become the prime focus of industrial energy management because of the rate of increase in prices and difficulty of substitution.

Natural Gas

The impact of the economic downturn is reflected in natural gas consumption. In 1990, industry used 32% of the total Canadian consumption and only 27% in 1982. This compares to a peak of 34% in 1987 when industry was stronger.

CIPEC reporting companies used 58% of the total 22.6 billion m^3 consumed in the total manufacturing and mining sector in 1990. About 80% of the CIPEC consumption is used as fuel while the remainder serves as feedstocks in the chemical sector.

The CIPEC monitored use is slightly less than total residential and farm consumption (14.2 billion m^3) but more than commercial use (10.1 billion m^3) and nearly 4 times the amount used in the transportation sector. The chemical industry is the single largest consumer using 3.8 billion m^3.

Industry's annual consumption of natural gas varies moderately with changes in product demand, weather and seasonal substitutions by other fuels.

Petrochemical feedstock conversions from offshore oil to domestic natural gas have also had a significant effect on recorded consumption. Manufacturing's demand has risen 23% in the last 10 years while mining's increase is less at 14% because of its greater reliance on fuel oil.

Industry uses large amounts of natural gas to generate electricity for itself and neighbouring town sites. In 1990, some 846 million m^3 was used for this purpose which amounted to one-third of the total demand. Several large CIPEC firms are now in the process of installing new cogeneration facilities to lessen their dependence on local electrical utilities as well as reduce the impact of Time-Of-Use electrical rates.

Industrial natural gas prices across Canada, according to the Cansim (PNGINCA), averaged 9.06 cents per m^3 ($2.43/GJ) in 1990. This is down from 9.11 cents per m^3 in 1989 and the peak of 12.56 cents per m^3 in 1984 just before gas deregulation. Manufacturers in Alberta enjoyed the lowest prices at 4.74 cents per m^3 while Quebec manufacturers had the highest at 14.99 cents per m^3. Industrial rates are 39% lower than commercial rates and nearly one-half the residential rates.

According to the National Energy Board, natural gas prices are expected to triple by the year 2010 because of shrinking production surpluses. Greater demand in Midwest U.S. non-interruptible consumption for generating electricity will be one of the chief reasons for the smaller surpluses.

Petroleum Products

Industry's fuel oil consumption amounted to 9.6% of the 3,509 PJ of total domestic demand in 1990. The transportation sector is the largest consumer with nearly one-half of the total domestic demand. CIPEC reporting companies' use of 182.4 PJ accounts for 54% of the total industry demand.

Within the surveyed companies refined petroleum products supply only 16.4% of the total which is down significantly from 24.3% in the past decade. Two-thirds of the reduction is due to substitution by cheaper natural gas and one-third by displacement with no-cost waste fuels. Statistics Canada also shows an equivalent share of 16.4%. Every province is well above this average percentage, except Ontario, which relies on oil products for only 9.7% of its total energy.

Industry uses small (1.6%) amounts of propane as fuel in spite of the wide fluctuations in prices, which nearly doubled to approximately $83.20 per m^3 in 1990. Propane is used in preference to oil where natural gas in unavailable. Quebec and British Columbia manufacturers increased usage in 1990 while others reduced consumption.

The estimated cost of refined oil products was $896 million throughout the CIPEC firms. Retail domestic heating oil prices, the largest component, averaged 34.7 cents per litre with +/- 20% variation across the country, according to Cansim (PLFDPCA). Prices have been quite stable since 1982 except for brief surges caused by the Persian Gulf war and other isolated events.

Coal and Coke

Companies in the CIPEC survey consumed 4.7 million tonnes of coal and 2.5 million tonnes of petroleum coke during 1990. The largest users were the steel makers, who transformed 3.5 million tonnes of coal into coke for their blast furnaces. Cement and lime making companies used one million tonnes of bituminous coal for kiln fuel.

Electric utility generating companies' coal consumption of 42 million tonnes was down from 46 million tonnes in 1988, partly due to reduced electricity demand and energy conservation by industry.

Industry's reliance on coal has steadily declined from the peak of nearly 21% in 1986 to 13.3%, because of reduced demand for steel products and displacement with cleaner-burning natural gas. Deregulation of natural gas contracts in 1985 helped lower prices to compete with coal which cost about $85/tonne ($2.65/GJ) in the two largest manufacturing provinces, Ontario and Quebec.

Industry's future use of coal may decrease even more because of the burdensome environmental impact of this carbon-rich fuel. Cement companies are still trying to convince environmental agencies that substitution with municipal refuse has positive environmental benefits, as well as needed cost savings.

Other Fuels

The "other" category includes a diverse mix of combustible wastes such as refinery off-gases, slops, bottoms, fish oil, used lubricants, etc. Unfortunately, there is no accounting of the tremendous quantities

of other combustibles such as packing crates, used pallets and other miscellaneous wastes.

Recovery and reuse of expensive hydrocarbons is largest in the petroleum refining and chemical companies. In these sectors, companies are improving their systems to minimize environmental emissions. Instead of flaring, more companies are cleaning and recycling waste streams back into feed lines.

A small number of general manufacturing companies now sell solid wastes to incineration companies but this is not yet a common practice. Disposal (tipping) costs can amount to $150 per tonne in the Toronto area. The mounting crisis in landfill site use is also causing more companies to study or expand disposal facilities.

Still, the actual use of wastes is thought to be greater than the 11% to 13% level annually reported by CIPEC companies. The pulp & paper and wood products industries are undoubtedly the largest users of nonrecorded wastes. In these instances, spent liquor and hog fuels are the main sources but are difficult to consistently measure and quantify.

It is expected that much greater recycling of materials and products and industrial use of wastes as fuel will be made in future. Attention to this overlooked potential may rival the efforts now directed to conservation of electricity and traditional fuels. The value of wastes as a fuel have been well known for many years. The problem is convincing the environmental regulatory bodies that these wastes can be used safely for a common good.

Weather and the Environment

Variable weather patterns have had a significant impact on industrial energy consumption and the use for each type of energy. For instance, across Canada in 1990, the average heating degree-days were 10% less than in 1989 and 11% less than 1985's when the CIPEC companies set their reference energy-equivalent consumptions. But 5% higher than normal cooling degree-days in industrialized Southern Ontario in 1990 added to building air conditioning and process refrigeration loads to offset some of the seasonal heating cost savings. Thus, less fuel was consumed while more electricity was used. Even though many surveyed companies commented on their regional weather effects, the overall impact is indeterminate because of practical limitations in the monitoring process.

In some cases, combustion systems on large steam generators, cat crackers and petrochemical reformers can adjust for variable weather conditions but these sophisticated installations are rare. In general, companies have been slow to install fully automated "feed-back" combustion control systems, fuel-air ratio controllers, low excess air burners, "free-cooling" refrigeration systems, variable head pressure refrigeration techniques, etc., because of the associated high capital and maintenance costs involved.

While better control and monitoring of combustion systems remains one of the highest potential sources of energy conservation and cost saving, the release of greenhouse emissions is now recognized as the major problem that requires government and industry attention.

The quantities of various emissions by CIPEC reporting companies are shown in Table II. Normal emission factors shown in Appendix A are those developed by Environment Canada. The emission factor for industry's electrical consumption is based on the fossil fuels used by each major utility and weighted according to the amount of industrial electrical consumption in each province. The conversion efficiency of generating electricity with fossil fuels was factored at 36%. The emission factor for the "other" category is a weighted composite of industry's primary fuels.

Canada's Green Plan already contains the concepts of how these damaging emissions will be monitored and controlled. Numerous studies are being done to determine the cost of this effort. One study, funded by a major Canadian oil company, suggests government will eventually impose a carbon tax of about $55 per tonne on carbon dioxide emissions to counteract this rising problem.

International discussions on control of greenhouse gas emissions are also in progress. Representatives of Canadian industry are participating in the Canadian Council on Climate Change Committee to prepare Canada's position for a Heads-of-State "Earth Summit" conference in 1992.

Among the industrialized countries, most of the European Community, Japan and Canada favour stabilizing total future carbon dioxide emissions at 1990 levels. Britain and Germany think it is possible to gradually reduce emissions so that 2005's will be 20% lower than 1988's. The United States is against any stabilization or mandatory cuts because of the unknown costs and consequences.

Whatever happens as a result of these international negotiations and eventual agreements, Canadian industry will feel the impact. Clearly, energy conservation and the need for greater operating efficiency has again become a major issue.

Table III

Greenhouse Gas Emissions

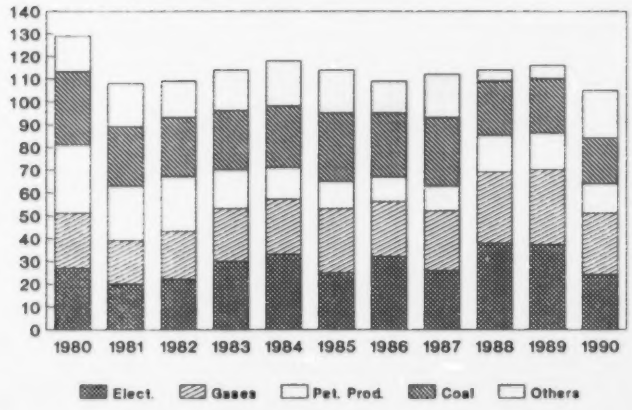
CIPEC Reporting Companies
(tonnes)

Energy Type	Terajoules	NOx	VOCs	SO_2	CO_2	Totals
Natural Gas	494,030	29,148	593	99	24,543,451	24,573,209
Electricity	291,634	32,151	194	186,303	24,183,499	24,402,147
Coal and Coke	202,944	50,736	253	295,882	18,691,183	19,038,053
Diesel	15,603	16,149	1,840	1,497	1,037,816	1,057,303
Light Oil	11,208	695	7	1,267	819,448	821,416
Heavy Oil	155,588	24,894	11,131	132,784	11,130,833	11,299,642
LPGs	24,740	1,484	1,484	0	1,480,496	1,483,465
Others	234,406	51,161	3,157	125,756	11,133,337	16,313,411
Totals	1,430,238	206,419	18,659	743,588	98,020,063	98,988,728

Environment Canada emission factors shown in Appendix B.

Figure 4

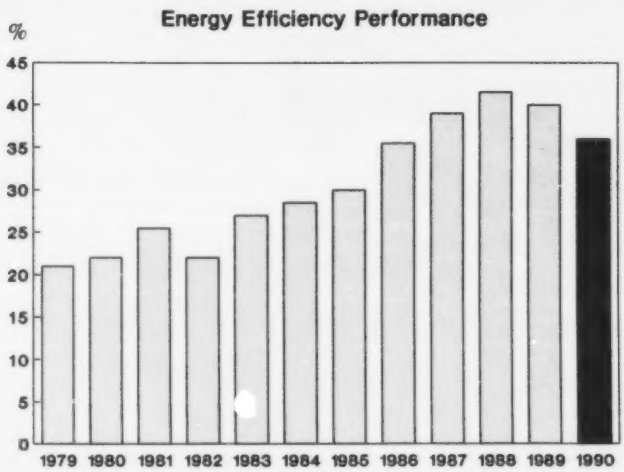
Carbon Dioxide Emissions



Chemical Industry

Energy Conservation Task Force

David Shearing
Chairman



Introduction

The information shown in this report comes from members of the Canadian Chemical Producers' Association (CCPA) which represents about 90% of the chemical manufacturing industry in Canada. About 80% of the CCPA companies' data are included in this survey.

The reporting companies range in size from those spending $175 thousand to $150 million per year for fuel and electricity. The approximate composition of this $11 billion industry can be classified as two thirds petrochemical, one quarter inorganic and the remainder split between the organic and specialty sectors. Some industry sectors, pharmaceuticals, consumer products and nitrogen fertilizers are not included.

This survey accounts for nearly 308 petajoules of energy. That is equivalent to 60 million barrels of crude oil or enough crude to fill a 2 foot diameter pipeline 29,000 miles long. This sum is greater than the Statistics Canada estimates for the chemical industry because this survey includes a sizable quantity of waste materials used as fuel and a different mix of final products.

1990 Performance

Energy utilization declined 4.2% during the year and thus fell that much below the 40% improvement target set for 1990. Nevertheless, this unusual negative performance comes when management is redirecting its attention to new energy conservation activities. As well, environmental concerns have become the major driving force in many energy management programs. The reemergence of energy awareness committees, a flurry of auditing activities including cooling water systems, long-term strategic site assessments, installation of low NO_x gas burners, etc., are signs of rejuvenating programs.

1990 performance, however, was affected by several business-related issues that worsened during the year and certainly were not foreseen when the efficiency target was set 5 years ago. In particular, the general effects of the 1989-1990 recession were not foreseen.

Recessionary economic conditions caused business profits (before taxes, interest and special writeoffs) to slip to $1,002 million from $1,855 million in 1989 in CCPA companies. Profits are expected to decline further in 1991.

Given these adverse conditions, companies operated with tighter budgets, again trimmed operating expenses, cut discretionary projects, mothballed some old plants and postponed major maintenance. Reports of the permanent shutdown of several inefficient units were noted in 1990. A few unplanned outages were also reported. As well, the slack times in some companies were used to debottleneck existing plants for better future performance, but these benefits are not always immediate.

Energy performance was thus hurt by a significant decline in capacity utilization, which according to the Statistics Canada method slipped to 89% from the 93% level in 1989 and 1988. In the 1982 recession, capacity utilization slipped deeply to the 64% level because the industry was then coming off a major expansion cycle. Though conditions in 1990 were more predictable and controlled, some companies especially noted the impact because of their

high base-load energy requirements and having to keep unused equipment protected against corrosion and freezeup.

It usually takes capacity use levels above 90% to prompt expansion. With utilization levels falling, capital investments tend to be directed into the "sustenance" category which is often simple in-kind replacement of existing equipment and machinery.

The widespread concern for the environment has also had a variety of impacts on energy performance judging from the number of comments in this year's survey. For example, one company's installation of a glycol recovery unit is saving a significant amount of material and disposal cost but uses more energy. On the other hand, another company reported recovery of large amounts of additional heat from its new waste material incinerator. In any case, there is agreement that environmental projects are getting the bulk of capital investment compared energy-related retrofits.

Even though new capital investment of $2,938 million throughout the industry ($984 million in the CCPA surveyed companies, excluding maintenance) rose 30% more than 1989's and 56% over 1988 spending, only about 3% of this was used for specific energy[1] retrofits. Of the $2,938 million total investment, $1,698 million (up 43% over 1989) went into new machinery and equipment while a steady $615 million was spent on maintenance. Both categories of investment normally provide future efficiency benefits but the high levels of recent spending were clearly not enough to support 1990's energy efficiency performance.

Apart from business affecting improvements, the number and scope of technical improvements have diminished in the past 5 years. A common emphasis remains on improvement of steam systems. Several companies reported ongoing steam trap maintenance programs, additional insulation, installation of low NO_x burners, increased recovery of condensates, and recovery of low-grade heat. Companies are anticipating even tougher environmental emission restrictions and have decided not to wait for government intervention.

Electrical systems are also getting more attention particularly in Ontario, because of Ontario Hydro's Demand-Side Management promotional audits and financial support. Several companies mentioned extensive conversion to high efficiency motors and installation of variable speed drives. New cogeneration facilities are being planned now because of better buy-back rates.

The way that chemical companies are now managed also has a profound effect on energy use and its performance monitoring both internally and in response to this survey. In general, stable energy prices and recent performance successes have gradually reduced the pressure on energy conservation programs. Routine monitoring and reporting have also been affected noticeably by changing ownerships, company decentralizations and management's strategy of shifting responsibility for energy efficiency down to the front-line operating level. In some of these instances the need for corporate performance monitoring and outside reporting has ceased altogether. In companies that have been privatized, performance results are sent only to their international head offices.

Much of the chemical industry itself is changing, which affects the way energy is used and monitored. For example, some traditional long life-cycle products are giving way to short-term products that are made in differently designed plants. A greater proportion of batch specialty plants are expected to be built in future. Substitutability of fuels and feedstocks, particularly in eastern Canadian petrochemical plants, is becoming a cause of concern.

With a new era of expensive environmental controls and escalating electricity prices looming (e.g., Ontario Hydro rates are expected to rise nearly 13% in 1991) energy conservation is expected to regain much of its former prominence. The above mentioned reemergence of awareness committees, fresh auditing, strategic energy use and overall site assessments, etc., are reminiscent of the energy management activities that took place when programs were formalized in the early 1970s.

Energy Consumption Trends

Table I shows that recovery of waste materials continues to grow. This trend is a result of past efforts to reduce the cost of purchased fuels and more now because of efforts to lessen the emissions of escaping gases into the environment. While no information exists on the Canadian chemical industry, the U.S. En-

1 Discussion Paper, Analysis of the Categories of Capital Investment, 1985-1987, Statistics Canada. J. Lacroix, November 1989.

vironmental Protection Agency (EPA) estimates that one-half the vent losses in U.S. chemical plants still come from leaking packing glands, seal tanks, compressor shafts and the like. One Canadian company reported this year that it had installed a major feedstock purification system to raise the quality of the gases to help process conversion efficiencies and lower venting losses.

Previous surveys also found that wastes are being recovered and purified for resale, but when this happens, they are not counted as fuels.

The group's increasing share of natural gas reflects not only the shift of the petrochemical industry closer to cheaper feedstocks and fuels in Alberta, but also a strategy to increase the flexibility of oil-based feedstocks in eastern Canadian plants. These plants can now operate on LPGs and LNGs when the cost differential between oil and gases swing past the optimum point.

Electricity consumption is also becoming a greater concern, primarily in Ontario, because of the possible shortage of dependable future supplies. One plant is therefore planning a 38.5 megawatt cogeneration unit for its site that would also supply half the electrical demand for the neighbouring town. The $37 million project would provide a modest financial return in addition to reduced emissions of carbon dioxide.

Table I

Energy Use and Trends

Type	Quantities (,000)	Gigajoules	1990	1985	1980
Natural Gas	5,130,826 m^3	190,866,740	51.0	44.4	36.8
Electricity	9,243,364 KWhr	97,526,744	26.0	34.7	31.1
Liquid Petroleum Products					
Distillate Oil	69,583 litres	2,901,172	1.0	0.9	10.0
Residual Oil	78,096 litres	3,292,100	1.0	4.2	14.4
Diesel and Gasoline	11 litres	459	-	0.5	0.4
LPG (propane)	7,474 litres	198,816	-	1.0	-
Coal & Coke	51.4 tonnes	1,194,000	0.4	0.3	2.3
Steam	n/a	6,642,744	2.0	2.0	1.0
Others*	n/a	69,180,475	18.6	12.0	4.0

Totals	1990	371,803,250
	1989	388,383,290
	1988	381,712,677
	1987	428,905,604

*Others include process by-products, vent gases, drips, slops, pitch, sulphur, hydrogen, waste oils, etc.

Table II

Energy Efficiency Improvement[2]

Current Year (1990) Total Energy Inputs	371,803 Terajoules
Base Year (1985) Equivalent Energy Inputs	393,041 Terajoules
Adjustments (1985-1990)	430 Terajoules
New Improvement = 5.4%	

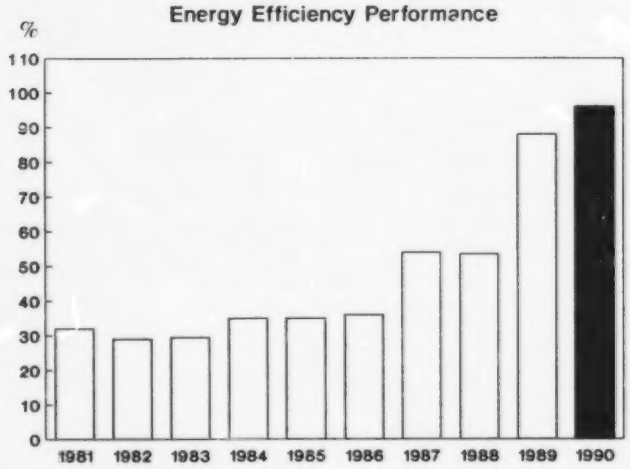
Efficiency Gain: 1973-1985	30.0%
1986	4.4%
1987	5.2%
1988	1.5%
1989	-1.6%
1990	-4.2%
Total Gain:	35.3%

[2]Energy efficiency trends are determined from the participating companies' returns on the basis of the gross electrical conversion rate of 10551 kilojoules per kWh. Overall consumption figures are adjusted to a common reporting base to reflect the shifts in energy mix.

Electrical and Electronic Industry

Energy Conservation Task Force

Steve Horvath
Chairman



Introduction

In 1990, the Electrical and Electronic Industry's Energy Management Task Force closed the book on a decade of success in the energy field.

But at the same time, it opened the book on a number of new challenges on the need to rethink its role; and on the corresponding need to reorient industry, government and community attitudes to both energy management, and to the Canadian industry's track record in this field.

For many of the past ten years, the Electrical and Electronic (E&E) industry has recorded double-digit improvements in energy efficiency. It surpassed its own 45 percent improvement target in 1987, three years earlier than planned. For many years, it led all industry sectors in reported efficiency improvements. Since its inception in 1976 this Task Force has left its mark on both CIPEC and on the industry itself.

Although it did not record its usually high percentages in 1990, the E&E industry's 9.3 percent improvement in energy efficiency compares favourably with most other industry sectors. Total reported energy consumption dropped to 3.3 million from 4.9 million gigajoules the previous year, partly because of a reduction of reporting companies.

However, the relative distribution of energy sources remained fairly consistent with 1989 figures. Natural gas accounted for 58.0 percent of energy consumed, and electricity stood at 38.3 percent. The only change was in liquid petroleum products, where consumption fell back to 1987 levels of around one percent (in 1989, oil consumption had jumped uncharacteristically to more than seven percent of energy consumed by E&E reporting members). Task Force members attribute this reversal to rising oil prices in 1990.

1990: A Year To Rethink the Future

The past year has been difficult for both the E&E industry and for Task Force members. The looming recession has forced the industry to tighten its collective belt. For Task Force members themselves, the major challenge in 1990 was to rethink its mandate and future. Two successful projects were mounted. A tour of Darlington and a review of the Ontario Hydro Demand Supply Plan each drew more than 40 company representatives. However, further plans to rebuild its educational profile were temporarily put on hold, largely because of members' preoccupation with business needs in the face of the 1990/91 recession.

The future of the E&E industry Task Force, and perhaps the future of CIPEC itself, will be driven by major changes in the Canadian economy, organizational structures and priorities. Key among these are the following:

- **The "slimming down" process continues unabated**
  Global competition and a tight Canadian economy have forced companies to severely rationalize both product lines and operations. Diversification is on the way out. More and more companies are returning to their core business, and through amalgamation and joint ventures within their industry sectors are strengthening their position to weather the rocky 1991 recession and beyond.

For the Task Force, the impact of this corporate streamlining is two-fold: the member product base is continuously changing; and immediate business needs are demanding a higher priority than energy management considerations.

- **The energy manager today is a rare commodity**
  Recession and rationalization have thinned the ranks of energy managers to the point where virtually none of the companies in the E&E industry Task Force employ a full-time energy manager. Instead, the energy manager's hat today is worn by the same individual responsible for safety, environmental issues, plant management or maintenance. Energy management thus is only one of the many issues on this individual's plate, and does not necessarily sit at the top of that individual's agenda.

- **Energy management is a "matter of course" for many companies**
  In recent years, energy efficiency has become a necessity as companies drive to be more productive and competitive. Most members have completed the most obvious retrofitting projects that yield astounding improvements in energy efficiency. Today, the majority of improvements will be through the purchase of new more efficient process equipment. Improvements in energy efficiency will continue, but the gains will be more meaningful in a highly competitive global market.

- **The "greening" of organizations puts energy efficiency in a new light**
  The heightened awareness of conservation in all areas of business and private life has helped to make energy management a way of life for many organizations. Companies today are buying state of the art equipment that is energy efficient and environmentally friendly; they are recycling materials and fuels in a number of innovative ways. The aim is to be an environmentally responsible corporate citizen; the result, often, is improved energy efficiency. Thus, in the drive to "green" their operations, companies have internalized the energy management function.

1991: A Year to Change Directions

In this kind of environment, change is inevitable. Faced with the need to change, Task Force members have identified two priorities for the coming year:

- **To position energy management as a sound business practice**
  The Task Force will endeavour to make members more aware of the energy savings opportunities that exist in the process area, an area in which substantial improvements can be realized. As manufacturers of the majority of energy conserving equipment, the E&E industry is well positioned to drive this message home to both its own members and to other appropriate sectors of industry.

- **To put Canadian industry on an even reporting footing with the rest of the world**
  Governments and major international organizations claim that Canadian industry is among the most consumptive, energy inefficient in the world today. Task Force members are concerned that the reporting base used to arrive at this conclusion may not represent the real picture; that in fact these organizations are not making fair comparisons, and may be painting an unrealistic picture of Canadian industry. These comparisons don't always appear to take into account the cold climate in which our companies operate, and the energy intensive nature of our industries (steel, pulp and paper etc.)

In 1991, Task Force members will work with other organizations and government officials to examine the possibility of conducting a study that would use "a level playing field" to compare energy consumption and efficiency of our industries with that of other major industrialized nations.

The pressures on our industry, and indeed on all Canadian industry, are many. To have external sources put unreasonable expectations on our industry to improve energy efficiency as a result of preconceptions or unrigorous measurement criteria, seriously undermines our already precarious global competitiveness. The challenge for the coming year, and the coming decade, is significant and crucial to our existence.

The more than 200 companies represented by the Electrical and Electronic Industry Management Task Force manufacture a diverse range of products used in the generation, transmission and distribution of electricity; examples include generators, transformers, lighting equipment, wire and cable and electrical appliances. Companies represented by this Task Force also manufacture a variety of electronic products, systems and related high technology components. The majority of these companies are members of the Electrical and Electronic Manufacturers' Association of Canada (EEMAC), which acts as a secretariat for the Task Force.

Table I

Energy Efficiency Improvement

Current year (1990) Total energy inputs		3,300,754 GJ
Base Year (1989) Equivalent energy inputs		4,023,362 GJ
Net Improvement		9.3%
Adjustments - None		
Efficiency Gain	1975 -1985	36.1
	1986	1.9
	1987	16.2
	1988	-1.2
	1989	34.7
	1990	9.3
Total Gain	**1975 -1990**	97.0%

Table II

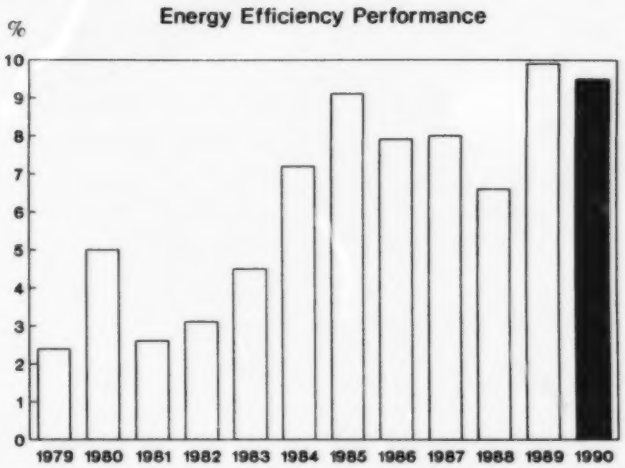
Energy Use and Trends

Type	Unit	Gigajoule	1990	1989	1988
Natural Gas	51,488,199 m^3	1,915,360	58.0	54.7	57.6
Electricity	350,717 MWh	1,262,583	38.3	35.1	36.7
Liquid Petroleum Products:					
Distillate Oil	348 kilolitres	13,586	0.4	2.5	1.0
Residual Oil	395 kilolitres	15,983	0.5	5.1	1.1
Diesel and Gasoline	117 kilolitres	4,696	0.1	0.3	0.2
Other Fuels:					
Propane	884 kilolitres	23,876	0.7	0.6	0.5
Steam	2,422,097 kilograms	64,670	1.9	1.7	2.9
Totals 1990		3,300,754			
1989		4,023,362			
1988		6,273,070			

Ferrous Metals Industry

Energy Conservation Task Force

Denis Jones
Chairman



Introduction

The year 1990 has been difficult for the ferrous industry in Canada. Some of the items contributing to the difficulties include a combination of prolonged strikes in two of the major integrated Canadian steel producers, increasingly poor demand for steel products, a deteriorating economy, aggressive inroads by foreign steel producers into Canada, the high value of the Canadian dollar, high interest rates and government's policies which continue to maintain high budget deficits. These items have occupied management's attention and forced energy related activities to a lower position on the steelmakers' agendas.

Reporting Update

Traditionally, the energy statistics submitted for inclusion in the CIPEC report by the Ferrous Industry Energy Research Association (FERA) represented a high percentage of the Canadian steel output (up to 85 per cent). In computing the 1990 statistics for the CIPEC report, only three companies agreed to participate, representing approximately 50 per cent of the potential Canadian steelmaking capacity. The three participating companies are:

- Algoma Steel Corporation
- Dofasco Steel
- Sydney Steel Corporation

1990 Composite Energy Performance

All current and past statistics have been adjusted to reflect only the current reporting companies. For the three reporting companies, steel produced was 5,348,579 tonnes for 1990. Total energy consumed was 121,951 x 10^{12} joules.

The amount of energy consumed per tonne of raw steel was slightly lower in 1990 at 22.8 x 109 joules than in 1989 at 22.87 x 10^{9} joules - a decrease of 0.4 per cent.

- Progress Towards the 1990 Energy Rate Goal.

The 1990 energy rate at 22.80 x 10^{9} joules per tonne was 0.4 per cent lower than the 1985 base year of energy rate of 22.9, and 5.9 per cent higher than the 1990 energy goal of 21.56 x 10^{9} joules per tonne.

Task Force Technical Activities.

Due to work stoppages at two of the companies participating in the CIPEC program, and the related reduction in manpower available to work on CIPEC tasks, many of the tasks and programs planned for 1990 did not take place.

In January, a senior representative from the International Flame Research Foundation Station, Ijmiden, the Netherlands, updated CIPEC participants on the IFRF research in:

- Near Field Aerodynamic Advances
- Low NO_x Burner Development
- Mathematical Modelling Studies

A contract was awarded to develop and detail a combustion workshop based on the outline developed by the committee. The first of the two-day

combustion workshops was conducted at Sydney Steel in September 1990.

In February the Technical Committee met at the CANMET Metals Research Laboratories to hear an overview of the energy research program of the Mineral Sciences Laboratories (MSL) and the strategic study of future ironmaking processes.

1990 Energy Conservation Projects

The following lists some of the energy conservation projects undertaken in 1990 by CIPEC participating companies:

- Boiler Feedwater Economizer
- Blast Furnace - heating and natural gas rather than cold blast sensible heat.
- Reheat Furnace Air/Fuel Ratio Trim Control
- Boiler Station Excess Oxygen Trim Control
- Scrap Preheat in Steelmaking Vessel
- Replace Solution Mixer with High Efficiency Unit
- Eliminate Deaerator Venting on Steam Systems

Table I

Ferrous Metals Industry
Energy Efficiency Improvement

Current year (1990) total energy inputs			121,951 terajoules
New base year (1985) equivalent energy inputs			122,482 terajoules
Gross Improvement	-0.4%		
Adjustments	None		
Efficiency Gains	1974-1985	9.1%	
	1986	-1.2	
	1987	0.1	
	1988	-1.4	
	1989	3.3	
	1990	-0.4	
Total Gain 1974-1990		9.5%	

Table II

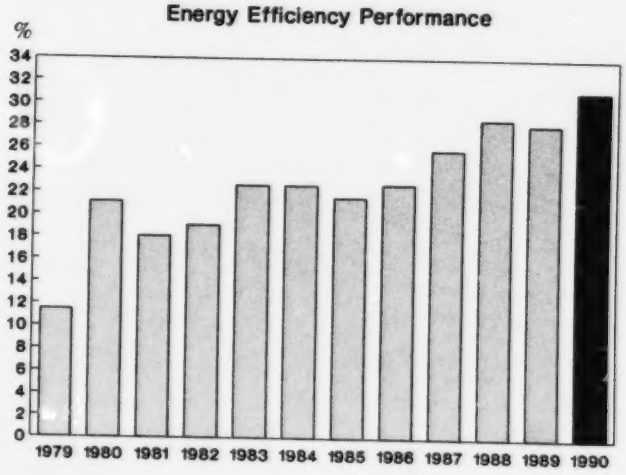
Ferrous Metals Industry
Energy Inputs

Purchased Energy	Quantity (SI units)	Energy Terajoules	Percentage 1990	1985
Natural Gas	388,360,220 m^3	14,447	11.8	10.6
Electricity	2,675,833,300 kWh	9,633	7.9	6.1
Residual Oil	250,493,830 litres	10,178	8.3	5.8
Coal & Coke	3,023,897 tonnes	87,693	71.9	77.5
Total purchased energy		121,951		

Food & Beverage Industry

Energy Conservation Task Force

Alexis L.W. Hyland
Chairman



Introduction

The 126 companies in this survey represent only the largest processing and manufacturing operations in this very diverse industry. Forty-one percent of the total industry energy consumption is covered in this survey.

Of the total 4,000 firms, about 90% are too small to monitor because of their small energy use and low energy intensities.

General Performance

Energy use improved 3% during the year, which was enough to attain the 31% goal that was set 5 years ago. The 1990 gain is mostly the result of several shutdowns of inefficient operations, tough recessionary strategies that focus greater attention on cost saving activities, and rapid adjustments being made to survive in the new Canada-U.S. Free Trade Agreement (FTA) environment.

The less serious negative effects of lower production levels, lower capacity utilizations, lower investment ratios, and leaner technical staffing would have had some effect, but these were not paramount, except in some individual sectors.

Total efficiency gains have slowed in the past 5 years to just under 2% per year compared to the earlier rate of 2.7% per year. Survey results show that productivity improvements are becoming more difficult and expensive to achieve. Many companies are postponing new investments.

Capital spending ($1.97 billion) dropped 6.6% for new construction and machinery in 1990 after rising nearly 8% in 1989. Meanwhile, the investment in maintenance was steady. Only a small proportion of this capital expense, about 3% according to last year's survey, is usually spent on energy improvements.

Energy conservation committees are starting to reappear in some companies to again focus attention on low-cost housekeeping and maintenance activities. These techniques are seen as effective ways of improve productivity without large capital expenditures.

Table I highlights individual sector performances. While the impact of the FTA has been more severe on food processing companies, all those in the industry have felt the effects of more intense competition sooner than expected. This has forced many companies to exchange or combine operations for economies-of-scale, and/or shut down and write off their least efficient smaller operations. Even so, falling capacity utilizations, which have steadily slipped to 81% in the food sector and 75% in the beverage group, do not reveal the extent of underutilized capacity yet remaining in some parts of the industry. This downsizing process is expected to continue and should help concentrate the group's efficiency.

Sector Performances

Bakeries

Except for the 2.5% efficiency decline in 1990, the 23% total gain has been a steady upward trend since the 1979 Base Year. Past optimization and new baking techniques are the primary reason for improvements. Total energy intensity for the various products in this group remains at 2,650 kJ/kg.

No significant energy management actions were noted this year as attention was directed to control of

production costs. Still, average energy intensity is about 16% higher than large U.S. operations where larger production runs are possible.

Consumption of electricity has grown from 13% in 1979 to 22% in 1990. Natural gas now supplies 62% of the energy.

Biscuit Manufacturers

Energy efficiency dropped 4.8% in 1990 following declines in the past three years. Average energy intensity is now up to about 5,900 kJ/kg of output.

Survey results show that few retrofits have been installed in the past three years and that most companies are relying on basic housekeeping and maintenance activities to sustain their energy efficiencies. When these activities are relaxed performance usually suffers.

Breweries

Aggregated energy efficiency has declined for a number of years and is now only 6% better than operating conditions in the original 1976 Base Year. Having to operate too many small local breweries to satisfy provincial trade regulations has not been conducive to the best operating efficiency. Energy intensities still average around 300 MJ/hectolitre for large plants and twice this amount in micro brewing operations. As a result, energy costs vary between 7% to 15% of direct factory expenses, depending on the size and location of each plant.

Two of the largest breweries merged in 1988 and this had a major impact on the consolidated results. As well, several micro breweries have become better established and now participate regularly in the survey.

Confectioneries

Total energy efficiency improved 16.2% in 1990 as a result of several product cancellations, shutdown of some inefficient sites, and general improvements to existing processes. For example, one company has installed economizers on its refrigeration equipment to vary the condensing head pressures and thereby take full advantage of cooler ambient temperatures in winter months. Installation of more efficient lighting and motors are popular in this sector.

Electricity now provides 35% and natural gas 62% of the total energy supply in the group.

Distilleries

The 4.4% decrease in energy utilization in 1990 is due to a further decline in production and consequent lowering (2.4%) of capacity use. Most plants report operating at a marginally efficient 75% capacity level. One plant was shut down in 1989 and another one is scheduled to be closed in 1991.

Energy intensity of distilled products averages 40,818 kilojoules per litre (absolute) throughout the sector.

Nearly all the surveyed companies show ambitious future improvement goals. Distillers tend to be quite progressive in keeping up with technology improvements and see increased productivity as a preferred means of maintaining profits.

Food Processors

Energy efficiency slipped less than 1%, which lowers the total gain since 1976 to 22.7%. Energy performance is muddled by a variety of mixed business conditions in this group with some companies increasing production and installing new equipment while others are shutting down because of thin profits. Aggressive use of provincial energy auditing programs and electrical utilities' Demand Side Management programs is a growing occurrence. Some new technologies, e.g., ultra filtration and membrane technology are seen as ways to lower energy intensities.

Fisheries

Energy efficiency gained 1.2% in 1990, which helped raise the gain since 1985 by 20.2% and 26% from the 1978 Base Year. While general business conditions have improved somewhat - GDP rising 5.5% in 1990, for example, better utilization of severely rationalized operations has been the main reason for the productivity gains.

Grocery Products

Energy utilization gained 2.6% during 1990 on the strength of some reported process modifications and modest factory improvements, for example, plant lighting, etc. The sector's GDP rose 5.2%, suggesting some volume increases although several plants reported operating at capacity utilizations as low as 50%.

Two-thirds of the 33% total gain was achieved between 1978 and 1985. Recent gains, while steady, are slowing because of reported higher implementation costs. Companies in this group are up-to-date on use of energy efficient equipment.

Meat Packers

The 2.8% decline in energy utilization dropped the total gain below the 40% level that had been achieved up to 1985. While most of the larger companies are reverting to basics with reductions of excess capacity, leaner organizations and fewer products, many of the smaller companies are shutting down. Performance was very mixed because of turbulent business changes. Some energy improvements were reported, e.g, additional water heat recovery, refrigeration system enhancements, switch to high efficiency electrical motors, etc., but the benefits are not widespread throughout the industry. Increased environmental control costs are also competing for available capital funds.

Poultry and Egg Processors

Energy utilization improved 8.8% in 1990, mostly as a result of 6.8% production increase. According to several reports, capacities are at peak rates. As well, companies are taking advantage of provincial energy audits to identify new improvement opportunities.

The egg and egg product firms still have low energy intensities in the 4500 kJ/kg range with energy about 1% of cost-of-shipments. The poultry processors have higher intensities, often with energy costs up to $150,000 range which are about 6% of manufacturing expenses. In some plants, refrigeration systems that maintain whole factories at 50°F and warehouses at 33°F are the main users. In others, extensive hot water systems are the chief energy consumers.

Soft Drink Producers

Those surveyed in this group report a total gain of 3.8% in energy efficiency in 1990. Several of the reports note that plants will be closed in favour of new larger facilities. About half the energy is used for plant HVAC and the other half for processing, sterilizing, and materials handling.

This industry uses as much energy as the distilleries and half as much as the breweries. Energy intensities are in the 3,500 - 4,000 kJ/litre range for bottlers and 1,500 kJ/litre for canners.

Sugar Refineries

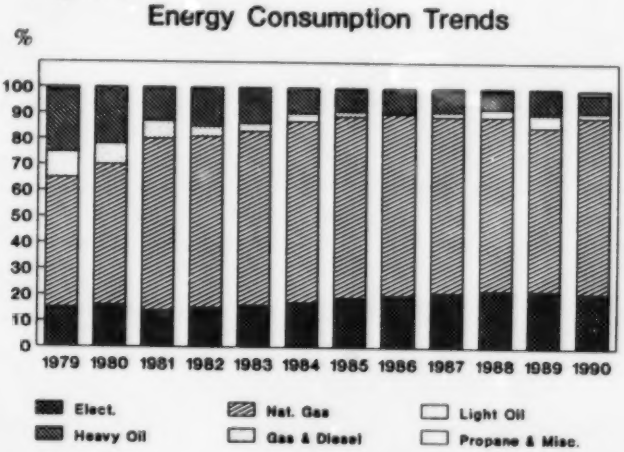
Performance dipped 1.5% because of minor production slowdowns that lowered capacities to less than top rates. Overall efficiency is still 45.9% better than 1975 operating conditions with energy intensities in the 3500 kJ/kg range. Refiners are still reporting increased efficiencies, however, with further improvements in steam and condensate systems, optimization of heat exchange systems based on pinch technology analysis, process changes, and application of high efficiency electric motors and peak controllers.

Wineries

Results of energy use in Canadian wineries are too sparse to monitor because, having the lowest energy intensities in the food and beverage industry, energy is not a major concern. Energy costs usually amount to just 1% of the value of shipments in this group. Even so, refrigeration systems are operated most efficiently because close attention is necessary for product quality.

Figure 2

Energy Consumption Trends



Energy Use and CO_2 Emissions

Improved energy efficiency is generally recognized throughout the industry as a major way to reduce the harmful effects of greenhouse gas emissions. Significant improvements have already resulted from switching to less carbon rich fuels and more efficient energy use.

Analysis shows that about 3,578,870 tonnes of CO_2 were discharged into the atmosphere by the surveyed companies from the 64,974 TJ consumption reported in 1979. The group's emission rate was equivalent to 55.08 tonnes/TJ of energy consumption. However, in the past eleven years of monitoring, the shifting energy mix has lowered the CO_2 emission rate nearly 6 t/TJ to the current level of 49.1 t/TJ.

As well, improved energy use (20.5% since 1979) has coincidentally lowered the CO_2 emissions rate 14.1 t/TJ. The total reduction rate of 20.1 t/TJ therefore represents a 3.9% per year environmental improvement rate. It is doubtful this rate can be maintained, however, partly because further fuel switching is unlikely and future energy improvements will be more expensive to carry out. Nevertheless, the definite linkage between environmental emissions and energy use will be closely monitored in these reports.

Table I

Sector Performance

Sector	Original Base Year	Consumption TeraJoules	1990 Eff. % Change	1985-1990 % Change	Total % Change	Estimated Cost ($MM)
Bakeries	1979	1,073.2	2.5	11.3	23.3	9.29
Biscuit Mfg.	1979	1,052.	14.8	6.8	16.4	8.23
Breweries	1976	8,004.5	2.6	0.7	6.0	59.05
Confectioners	1981	1,588.8	16.3	15.3	41.0	14.76
Distillers	1977	5,961.5	-4.5	8.1	25.8	37.93
Fisheries	1978	1,361.7	1.2	6.3	26.5	12.39
Grocery Prod.	1978	4,526.5	1.1	9.9	33.3	35.87
Meat Packers	1978	3,218.1	-2.8	-1.5	38.5	27.60
Poultry and Egg	1982	809.6	8.2	3.5	11.8	9.43
Food Processors	1976	4,991.0	-0.5	6.2	22.7	35.62
Sugar Refiners	1975	2,534.9	1.5	17.6	45.9	9.2
Soft Drink Prod.	1988	1,318.8	3.8	6.0	6.0	0.93
Wineries	1988	n\a	n\a	n\a	n\a	n\a
Totals	1977	36,442.3	3	9.8	31.3	275.71

Table II

Consolidated Energy Use, Trends, and Emissions

Energy	Quantity	Terajoules	Proportions (%) 1990	1985	1979	CO_2 Emissions tonnes
Natural Gas	620,177,663 m^3	23,070.6	65.4	69.78	50	1,184,893
Electricity	2,084,401 MWh	7,503.8	21.29	18.54	15	269,024
Liquid Petroleum Products:						335,543
Light F.O.	44,708,489 litres	576.4	1.64	1.19	10	
Heavy F.O.	71,563,757 litres	2,851.0	8.09	9.53	24	
Diesel, Gasoline	21,025,239 litres	825.5	1.97	0.17	1	
Steam	n\a	1.7	n\a	n\a	n\a	
LPG, Propane	15,438,823 litres	410.7	1.17	0.5	0	
Miscellaneous	n\a	10.7	0.37	0.29	0	
1990 Total Consumption		35,250.3 Terajoules				1,789,160
1985 Base Year Equivalent Consumption		39,054.0 Terajoules				

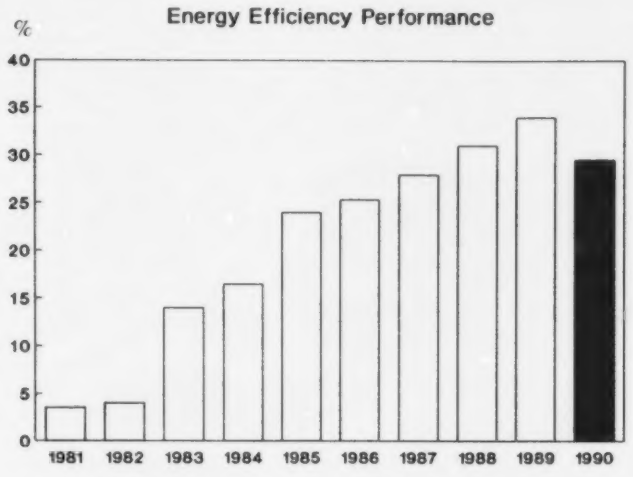
Efficiency Improvements

1977-1985	21.5%
1986	1.2%
1987	3.1%
1988	2.8%
1989	-0.5%
1990	3.0%

General Manufacturing

Energy Conservation Task Force

Bent K. Larsen
Chairman



Introduction

This survey profiles the energy management trends and concerns from a variety of general manufacturing companies. For annual monitoring the companies have again been segregated into light manufacturing, metal fabrication, and continuous processing. The combined results provide a good picture of general conditions throughout the manufacturing industry.

The cost of energy in the participating companies ranges from $100,000 up to nearly $28 million. About two thirds of those surveyed have moderate energy costs in the $500,000 to $700,000 range. Even though energy costs usually average about 5% of manufacturing expenses, energy remains a significant concern throughout this sector. The estimated total cost of fuel and electricity for the participants is $143 million at an average cost of $7.55 per gigajoule.

It is not possible to claim a percentage of sector coverage because of the loose definition of general manufacturing and the speed of business changes occurring throughout the industry.

General Performance

While energy utilization declined 1.8% in 1990, the average energy intensity level has been improved by 6.2% since 1985. Results show performance has risen 29.6% since 1979. This overall performance result did not achieve the 33% target figure that was set 5 years ago but is considered satisfactory in view of the impact of unforeseen events that have occurred during the past 5 years.

About half the participating companies did not specify any future performance targets. Of the other half, most foresee only nominal performance increases of about 2% per year. Four companies reported ambitious 10% per year performance goals for the next three years.

Metals Group

The metals group, composed mainly of energy-intensive foundries, forging shops, tool manufacturers and the like had a 1.2% improvement in energy efficiency which boosted the overall gain to 23% over 1982 usage. Natural gas provides the biggest share of energy at 56% with electricity next at 38%. Some modern foundries in Quebec use only electricity for power. This is the only group that reports use of waste fuels (1.2%) to supplement the small consumption of other fuel oils.

Light Manufacturing Group

This group's average performance declined 4.5% during the year. Energy use has improved 18.3% since 1984 however The most significant reason for this year's decline was reduced consumer demand which lowered manufacturing's production and capacity utilization by 5.3%. Companies in this sector tend to have relatively high base-energy loads, for example, HVAC, etc., which make energy efficiency very sensitive to changes in production and capacity use.

Factory automation, which is increasing, also uses more energy per unit of output and results in greater use of electricity. The electricity share is now up to 29% from 26% in the past decade. Natural gas now supplies 65% of the total, petroleum products 2.9%, and others, which consist mainly of purchased steam, supply a nominal 2.3%.

Processing Group

This group, most of which make a variety of rubber products, has seen a recent slide in performance results because of decreasing production levels and slow investment in new facilities. The group's energy use dipped 1.7% during 1990, 2.5% in 1989, and 3.2% in the previous year. Overall efficiency, however, is 38% greater than the 1978 average because of large gains made between 1982 and 1985.

The electricity share has slowly risen to 32% since monitoring began while petroleum products have shrunk to 33%. Natural gas provides 34% of the total energy.

General Analysis

General performance during the past eleven years shows the impact of different business conditions on energy performance. During the '81-82 recession, for example, manufacturing companies first cut back production to trim inventories and satisfy short-term sales forecasts. At the same time, business strategies were revised. Greater productivity became a need for survival. Energy usage remained flat when production was severely cut back (16%) even though many inefficient sites were shut down and energy conservation programs were revitalized.

The fastest annual rates of energy improvement followed the 1982 recession. Energy efficiency jumped ahead by 10% in 1983 when production output increased instead of shrinking as it did in 1982. Capacity utilization in the durable-goods sector had sunk to 58% in the third quarter of 1982 (only to 77% in 1990). With improving business conditions in the next six years, energy efficiency saw corresponding increases.

Business conditions were much different in 1990, however. Most companies were making basic changes to survive not only the current recession but also the sweeping impact of increased foreign competition. By 1990 many firms had become much leaner and had shrunk back to core operations. Capacity utilization declined only 4.7% but this was harder because of the reduced excesses. Consolidated energy efficiency trends were negative because more participating companies reported declines than increases.

Closer analysis of the production-related effects reveal that almost two-thirds of the overall efficiency gains have come from product changes including material substitutions, etc. This was determined from statistical regression analysis of the relationship between energy efficiency, production output, capacity utilization, and other secondary influences such as energy prices. Capacity use, which is less now than it was in 1979 when monitoring began, has depressed overall efficiency by 7%. The influence of increased energy prices was negligible. The one-third remainder of the measured efficiency gain, disregarding the negative effects of capacity, is therefore attributed to technological improvements. This final net component represents the extent of improvement in facilities and equipment, retrofits, better procedures and maintenance, etc.

The above key sources of efficiency gain should be appreciated when it comes time to set future performance standards and goals - especially when energy efficiency gains are linked with reduction of greenhouse gas emission targets.

Energy and the Environment

Surveyed companies were asked to provide their initial response to possible government initiatives that relate to reduction of greenhouse gas emissions. In future, it is recognized the efficiency and purpose of energy consumption will likely be subject to very close scrutiny.

The following potential items are simply ranked on a scale of (1) strongly against, (2) somewhat against, (3) undecided or neutral, (4) mildly support, and (5) strongly in favour. In general, those items with the highest average score also had the greatest level of agreement. The opposite was shown for the low ranking items.

Of all the items listed, technical information news and seminars were thought to be the most effective technique for helping to improve energy efficiency, and in turn, to reduce environmental emissions. The least effective method was government intervention in energy prices. Anything to do with mandatory requirements, e.g. efficiency targets, inspections, reporting, etc., drew the least applause and widest disagreement.

Table I

Environmental Considerations	Average Score
"Polluter Pays" Principle	3.97
Effluent Charges	3.69
Emissions Trading Scheme	3.32
Mandatory Performance Inspection	3.00
Government Energy Price Intervention	2.55
Energy Related Considerations	
Retrofit Tax Allowances	4.39
Financial Grants	4.28
Low Interest Rate Loans	4.25
Minimum Equipment Standards	4.03
Minimum Facility Standards	3.97
Minimum Process Standards	3.82
Mandatory Energy Efficiency	3.21
Government-Industry Cooperation	
Energy Efficiency Information	4.55
Technical Transfer Seminars	4.33
Continued Voluntary CIPEC Program	4.18
More detailed CIPEC Reporting	4.00
Energy Monitoring Software	4.00
Energy Performance Awards	3.76
Special Training Centres	3.52
Voluntary Technical Audits	3.38
Electronic Bulletin Boards	3.03

Table II

General Manufacturing Industry

Energy Use		Gigajoules	Percent Distribution		
Type	Units (,000)	(10^9)	1990	1985	1980
Natural Gas	275,205 m^3	10,237,660	53.8	60.2	52.9
Electricity	1,810 MWh	6,518,010	34.2	28.1	26.1
Liquid Petroleum Products					
#2 Oil	9,336 L	364,117	1.9	1.2	1.8
#6 Oil	34,995 L	1,302,641	6.8	9.6 1	5.9
Diesel	1,984 L	79,198	0.4	0.4	2.3
Gasoline	1,955 L	70,779	0.3	0.1	0.7
Other Fuels					
Propane	8,329 L	221,572	1.2	0.3	0.2
Steam	n/a	130,751	0.7	0.2	-
Others	n/a	108,673	0.6	0.1	0.1
Totals		19,033,400			

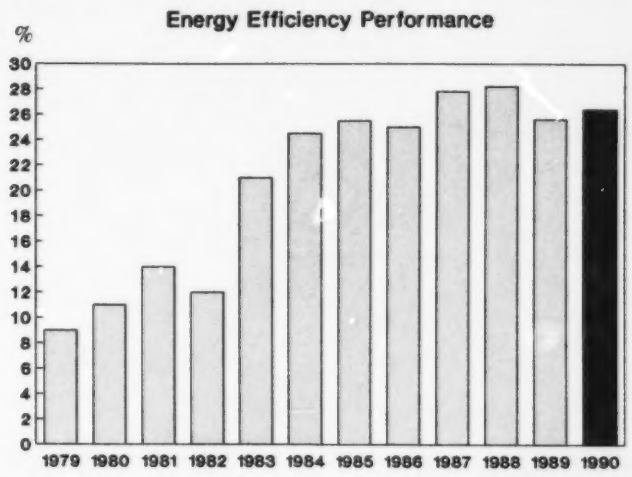
1985 Base Year Equivalent Consumption: 20,293,590 Gigajoules

Net efficiency 1985-1990	6.2 %
Energy efficiency gain 1981 to 1985	23.4 %
1986	1.9 %
1987	3.8 %
1988	3.0 %
1989	-0.4 %
1990	-1.8 %
Total energy performance improvement:	29.9 %

Industrial Minerals Industry

Energy Conservation Task Force

Mr. John M. Lind
Chairman



Introduction

The Industrial Minerals group consists of 9 different sectors that mine, process and/or manufacture a variety of non-metallic products for later use in the construction and steel making industries. The combined GDP of this industry amounted to $13.2 billion in 1990.

This survey represents 75% of the total energy consumption in the industrial minerals industry. Nearly 95% of the cement industry is included. In the medium energy-intensive sectors, abrasives, asbestos, glass and lime, about 75% of the total energy consumption is surveyed. In the less energy-intensive groups, which consist of some 1200 companies, about 20% of companies are represented.

General Performance

Energy efficiency has varied by small amounts in the past 5 years resulting in a net gain of only 1% since the 1985 reference levels. 1990 performance was up 0.6%. From the original 1977 Base Year, overall performance had increased 25.4%, but fell short of the 35% target set for 1990. The annualized improvement rate of 3.1% per year was achieved in the early years of monitoring when incentives and business conditions were more favourable.

1990 performance was affected by a severe downturn in the construction industry which reduced cement production volumes by 6.5%, concrete products output by 12% and redi-mix concrete business by 23%. Production volumes in other sectors were down by lesser amounts. Group capacity utilization thus slipped from 77% in 1989 to under 76% in 1990.

Very little of the total efficiency improvement has come from new or revised processes in this industry. Most of the manufacturing processes are very mature and not subject to major changes. There is improvement potential, however, as noted below in the individual sector reports. Maintaining the effectiveness of equipment insulation, heat recovery, closer control of combustion systems and electrical demand are common opportunities for energy conservation throughout the industry.

Sector Reports

Abrasives

Abrasive manufacturers' energy performance dropped 2% in 1990, primarily because of a 6% drop in production. The total gain since 1982 is 12.4%.

The energy intensity of silicon carbide products ranges from 12,000 to 14,000 megajoules per tonne of output - depending on furnace configuration. Raw aluminum oxide requires 10,000 MJ/tonne to make. The surveyed companies' energy mix is still 88% electricity and 12% natural gas. High efficiency motor replacements and careful load scheduling are popular energy management items.

Asbestos

After several years of reduced market demand and industry rationalization, 1990 was a good year with 3.3% increased efficiency. Energy intensity averaged about 6,570 MJ/tonne of processed raw fibre throughout the industry, but there was wide variation because of the different quality of fibre.

Companies are forecasting energy efficiency improvements between 2% to 5% per year up to 1995. The British Columbia mine is switching from an open

pit to underground operation. Good housekeeping, attention to maintenance and minor heat recovery projects are yet the mainstay of energy conservation in this sector.

Cement Manufacturing

1990 energy use was even with 1989 rates even though clinker production fell 6.5% to 10.5 million tonnes. Reported capacity is now 83.6%. Anything less than 100% is a drag on efficiency.

Overall, energy intensities have improved 1.2% since 1985 but a more satisfactory 24.6% since the 1974 Base Year rates. Average energy intensity is 4,969 MJ/tonne for clinker production with lower 4,724 MJ/t in dry plants and higher 6,013 MJ/t in wet plants.

While coal and coke provide 64% of the fossil energy input, cement manufacturers are trying to reduce consumption of these carbon-rich fuels to lower costs and reduce CO_2 emissions. For instance, St. Lawrence Cement Inc., Eastern Canada's largest producer, has tried for some time to get environmental approval to burn municipal wastes in its Mississauga plant as done in many U.S. and European plants. In a 1988 survey, the Portland Cement Association (PCA) found that 32 of 87 world plants use wastes such as tires, waste oil and solvents to supply 5.2% of the total energy input. Half of the Canadian plants get only 1.9% of their fuel from waste materials.

The 1988 PCA study also found there is a large difference in operating efficiencies throughout the world. Canadian cement makers are 19% more efficient than U.S. and 10% more efficient than English plants. However, Canadian plants are 27% less efficient than Japanese, 24% less than Swedish, 23% less than Swiss, 14% less than French, and 7% less than Spanish plants.

Clay Brick, Tile and Clay Products

Clay product manufacturers' performance gained a marginal 0.5% in 1990 to raise the total gain since 1977 by 26.9%. This sector also suffered from the construction slump but attention to plant productivity was successful. Brick making plants are highly automated operations with computerized controls.

The energy intensity of clay bricks averages 3,585 MJ/tonne (1.8 tonnes/1,000 equivalent units) while batch making of other clay products, i.e., tiles, sewers, etc., is often three to four times the intensity of brick manufacture.

Concrete Products

This diverse sector has about 900 different concrete block making and redi-mix operations spread throughout the country. Product energy intensities are the lowest in the industry with block making in the 350 - 500 MJ/tonne range.

Because of the above, performance varies more than other groups. For instance, survey results show efficiency increased 3.5% in 1990 though production dropped 11.9%. When this scenario happens, it usually means the least efficient plants are shut down to keep capacity at the better plants up. Surveyed companies report that downtimes are being used to upgrade equipment and improve steam curing and boiler systems.

Glass

This survey includes only the seven largest multi-plant primary producers that use about 80% of the total energy consumed throughout the industry. Manufacturing performance increased 0.7% in 1990 to raise overall productivity 35% above 1978 Base Year operating rates. Efficiency suffered from the 8.7% decline in production that resulted from the construction slump and continued competition from the plastic container industry.

The glass industry offers some sharp contrasts in the way energy is used and how energy intensities can vary. For example, glass making is a very energy-intensive operation requiring about 4.7 GJ/tonne for the melting operation alone. Since much of the industry operates at the high value-added forming and decorative end of the business the ratio of energy cost versus sales (about 6%) is one of the lowest in the surveyed group. This survey is based on energy use per tonne produced.

Lime

Energy efficiency in this group fell 4.6% due to a 10% drop in production and corresponding drop in capacity utilization. Performance was helped somewhat by reported improvements in kiln operation, installation of high efficiency motors and electrical demand controllers.

In the past 5 years of monitoring a significant shift of the energy mix to less CO_2 polluting fuel has been made. The proportion of coal use has been

reduced from 42% to 24%. Natural gas, electricity and heavy fuel oil use have each gone up 5%. This trend has now stabilized given the relative economics of the different fuels and process technologies.

Miscellaneous Minerals

Total efficiency in this diverse group was marginally up 0.4% to raise the gain 12.8% more than 1977 operating conditions. Even though the surveyed companies produce a vastly different range of products, the production techniques used are much the same, i.e. crushing and pulverizing, milling, refinement and drying. Electricity is the dominant source of energy (57%) while 36% is provided by natural gas for product drying and heating purposes.

Electrical systems thus continue to receive the most attention. Maintenance and housekeeping were also reported as important energy management activities.

Refractories

Surveyed companies continue to report that short-run production and ever changing product mix make it difficult to track performance accurately. Energy consumption has decreased 5.8% in the responding companies but this is not tied to corresponding production changes.

Nevertheless, companies report that energy conservation is an active management pursuit. From previous reports, most have shown that technical audits have been made and economic opportunities have been acted upon.

The energy intensities of fired products are in the 6,500 MJ/tonne range and energy costs usually represent about 40% of the manufacturing expenses. About 85% of the total energy is supplied by fossil fuels, which can be either natural gas or fuel oil depending on the location of the company.

Energy Use and CO_2 Emissions

Energy conservation and substitution of less carbon-rich fuels are prime techniques for lowering emissions of greenhouse gases. Since CO_2 is the major focus of current attention, the trend of its release from the fuels and electricity used within the surveyed companies has been calculated.

Based on the fuels and electricity used in 1979 compared to 1990, for instance, the rate of emission related to fuel substitution went up from 66.3 tonnes/GJ to 74.2 tonnes/GJ consumed. This fuel-substitution effect resulted from a shift from fuel oils to cheaper but more carbon-rich coal. Fuel oil emits* from 71.54 to 73.1 tonnes per terajoule while Canadian bituminous coal gives off 92.1 tonnes per terajoule when burned.

However, increased energy utilization during the same period had a more positive impact. Energy efficiency increased 16.8% between 1979 and 1990 and, in effect, thereby lowered the rate of CO_2 emissions. Based on the 7,520 terajoules of energy used in the surveyed companies in 1990, and assuming the efficiency increase applies equally to all fuels, the rate of emissions would have been 12.5 tonnes/TJ higher without any increased efficiency. The net emission improvement rate is therefore 4.6 tonnes/TJ. For the surveyed companies this amounts to 34.6 thousand tonnes less CO_2 dumped into the atmosphere in 1990 compared to operating conditions in 1979.

Table II displays the total consumption and trends of each type of energy used.

**Carbon dioxide emission factors, Environment Canada, Report EPS 5/AP/2, May 1990, p xvii*

Table I

Group Energy Consumptions and Performance

Sector	1990 Consumption Terajoules	1990 Eff.% Gain	Total Eff.% Gain	Total 1990 Target	Base Year
Abrasives	3,105	-2.06	12.4	20	1982
Asbestos	5,137	3.29	12.9	10	1979
Cement	52,130	0.00	24.6	40	1974
Clay Brick	3,434	-1.54	26.9	40	1978
Concrete Products	974	3.58	22.2	20	1979
Glass	21,829	-1.03	35.6	50	1974
Lime	6,492	5.00	18.1	25	1979
Miscellaneous	6,770	0.57	12.8	15	1977
Refractories	1,427			15	1978
Total	101,303	0.66	26.4	35	1977

Table II

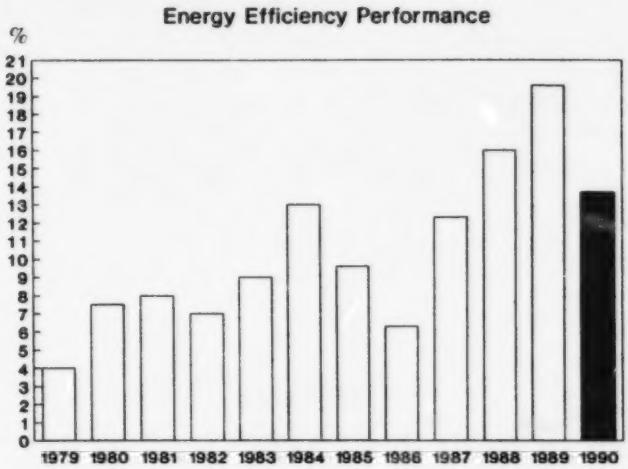
Energy Use and Efficiency

Type	Units	Petajoules	Distribution % 1990	1985	1979
Natural Gas	1,130,959,488 m3	41.174	40.6	42.6	44.9
Electricity	5,121,401 MWh	18.419	18.2	15.5	13.9
Liquid Petroleum Products:					
#2 Fuel Oil	15,883 kL	0.61	0.6	0.6	2.7
#6 Fuel Oil	110,546 kL	4.490	4.4	4.0	14.5
Diesel & Gas	60,610 kL	2.402	2.3	2.0	7.4
Coal	991,900 T	31.840	31.4	34.0	15.8
Other Fuels:					
Propane, Naptha, LPG	17,367 kL	0.458	0.4	0.2	0.2
Steam		1.903	1.8	1.0	0.6
Total 1990		101.303			

Mining & Metallurgy Industry

Energy Conservation Task Force

Paul B. Batten
Chairman



Introduction

The companies in this survey produce several basic metals, minerals, by-product fertilizers, and synthetic oil. The principal metals processed include: gold, copper, nickel, lead, zinc, silver, iron, and molybdenum.

This survey covers 85% of the integrated metal mining operations as well as one major tarsands synthetic oil producer and a large potash mining operation. All 19 surveyed companies, with 46 different operating sites, are members of the Mining Association of Canada (MAC). At last count there were 123 integrated mining companies operating throughout Canada.

Performance

Combined efficiency declined 5.8% in 1990 even though many individual results were positive. Industry performance has also varied since monitoring began in 1977. Performance has advanced 7 times and receded 6 times. Performance in this resource-based industry is clearly very sensitive to domestic and international business conditions. For example, world commodity pricing affects selling prices and profit margins which influence investment patterns more than most other manufacturing industries.

The overall efficiency improvement, however, is 4.1% better than 1985 reference values and 13.7% more efficient than the 1973 Base Year operating conditions. The lower 1990 performance thus caused the total gain to slip below the 5 year term improvement goal of 15%.

In spite of the reduced 1990 performance efficiency, the annualized cost saving still amounts to $8.4 million per year. This is based on an estimated total cost of $1.02 billion for electricity and fuel and the overall rate of improvement since 1985. The average cost of energy throughout the industry was about $4.76 per gigajoule. Costs can vary by +/- 15% depending on availability of direct-purchase natural gas.

Energy costs often amount to about 5% of the value of shipments in integrated mining operations according to recent Statistics Canada (cat.#26-223) data. This percentage is steadily climbing because energy prices are escalating faster than product selling prices. In small remote sites, studies have shown that energy costs often add up to 30% of production expenses.

Factors that Affected 1990 Performance

The severe 1989-1990 recession is the major cause of reduced production volumes, lower capacity use and energy efficiency. As well, several companies experienced unusual production outages for inventory control or prolonged labour negotiations.

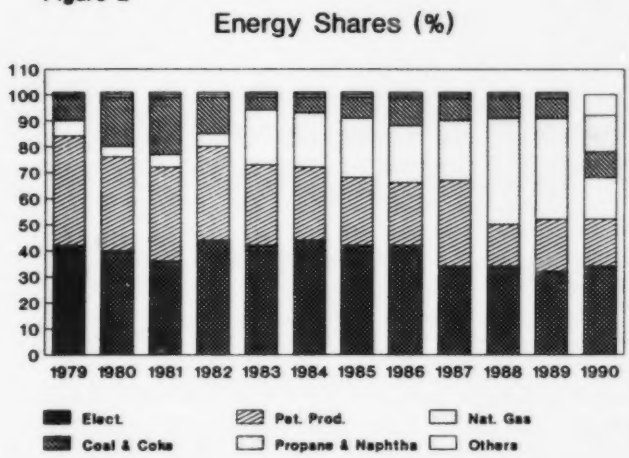
Productive capacity fell from 92% to 86% in the larger surveyed companies during 1990. The industry wide average, according to the StatsCan method of calculation, declined from 86% to 85% in 1990. Some gold mining companies reported operating at 50% capacity.

The dominant gold mining sector was hit especially hard with shutdowns of many marginal operations. Throughout 21 of the major companies in 1990, the extent of asset writeoffs amounted to $1.4 billion with $1 billion of this in the gold mining sector alone.

Paradoxically, these shutdowns would have had a helpful impact on overall performance, but these effects cannot be measured. Several companies reported future shutdowns will be necessary to offset the losses caused by low metal prices.

Low profit margins also curtailed investments normally made to upgrade and improve existing operations. After reaching peak levels of income in 1988, industry-wide spending on new facilities declined from $2.1 billion to $1.5 billion in 1990. Non-capital spending on maintenance was stable at $1.2 billion. Energy efficiency is often helped significantly by minor improvements and housekeeping actions. The most rapid decline (57%) in total capital spending, however, occurred in the gold mining sector.

Figure 2



Now there is a growing environmental concern that has started several energy-intensive waste-recovery projects throughout the industry. Most of these new installations also compete for scare investment dollars. For example, INCO reported that $155 million of its 1990 $500 million capital budget will be spent on a new sulphur abatement project at its Sudbury site. This energy-intensive project is expected to hamper site energy efficiency for 3 years. Similarly, Hudson Bay Mining and Smelting Co. Ltd. is also planning a major waste recovery project at its Flin Flon smelter.

Meanwhile, housekeeping type activities such as combustion improvements and steam use reductions continue to be the backbone of energy conservation efforts. One multi megawatt cogeneration project is also under investigation but will take at least 2 years to install.

Energy Use Trends

The surveyed energy consumption shown in Table II amounts to 143,357 terajoules, which is equivalent to 3.72 million m^3 (23.4 million barrels) of crude oil. This survey therefore represents about 85% of all integrated and related mining operations. The survey does not include asbestos mining, oil wells and quarries that are normally grouped in the same Standard Industry Classification (SIC) "06" classification.

Past shifts in energy shares have occurred more because of changes in the reporting population than due to fuel substitutions. Early surveys contained a greater number of coal mines and locations not having access to cheap natural gas. In the past three years, Syncrude's higher percentage of off-gas fuels have also had a major impact on the total share picture, as shown in Figure 2.

Future substitution trends will probably show the effects of large-scale cogeneration projects as well as possible limitations on emissions of greenhouse gases.

Energy Use And The Environment

With increasing concern about the emission of greenhouse gases into the environment, a preliminary analysis of CO_2 effluents was made. This was done to determine the overall effects of fuel substitutions and reported efficiency improvements.

The various methods of generating electricity in each province, i.e., from polluting fuels such as coal as well as non-polluting hydraulic sources were taken into account. Representative CO_2 emission factors were also applied to the surveyed fuel consumptions.

The results indicate that 7.4 million tonnes of CO_2 were discharged into the atmosphere from the fuel and electricity used by the surveyed companies in 1990. Based on a realigned reporting population, CO_2 emissions were reduced 17% (1.2 million tonnes) between 1980 and 1990. More than half the reduction (10%) was due to fuel substitutions while less than half (7%) was due to the reported efficiency increases.

It is unlikely that similar future environmental improvement gains will be available from these two

energy management sources. A reduced rate of fuel substitution and slower efficiency increases should be expected given the current forecast of business conditions. There will probably be more electricity used in mining operations but the emissions differ from the various methods of generation.

Looking to the future, companies were asked to consider and rank several possible government initiatives (Table I) that could impact on energy efficiency and consequently on CO_2 emissions. These were ranked as: 5 = strongly in favour to 1 = strongly against. Some of these initiatives have already been mentioned in the Federal government's new Green Plan. Others may be contained in the upcoming National Energy Efficiency Act.

Table I

Increased technical transfer activities	
Technical Seminars	4.6
News Publications	4.3
Energy Monitoring Software	4.1
Regional Training Centres	3.7
Consulting Assistance, surveys	3.5
Electronic Bulletin Boards	3.4
Financial Assistance	
Accelerated Tax Incentives	3.9
Special Grants	3.6
Low Interest Rate Loans	3.6
Possible Legislation	
Emissions Credit and Trading Programme	2.9
Mandatory Energy Efficiency Monitoring	2.9
Effluent Charges	2.9
Mandatory Performance Inspections	2.7
Energy Price Intervention	2.0

In general, while most (3.8) favour the 'Polluter Pays Principle', the responders felt that increased technical transfer activities (4.3) would provide the broadest and most useful benefits. Some form of financial aid is considered helpful while additional government intervention is unwanted.

Table II

Energy Efficiency Improvement

Current Year Energy Consumption		143,357 Terajoules
Base Year (1985) Equivalent Energy		148,309 Terajoules
Adjustments		1,190 Terajoules
Net Improvement (1985-1990)	4.1%	
Annual Changes 1973-1985	9.6%	
1986	-3.3%	
1987	6.0%	
1988	3.7%	
1989	3.6%	
1990	-5.9%	
Total	13.7%	

Table III

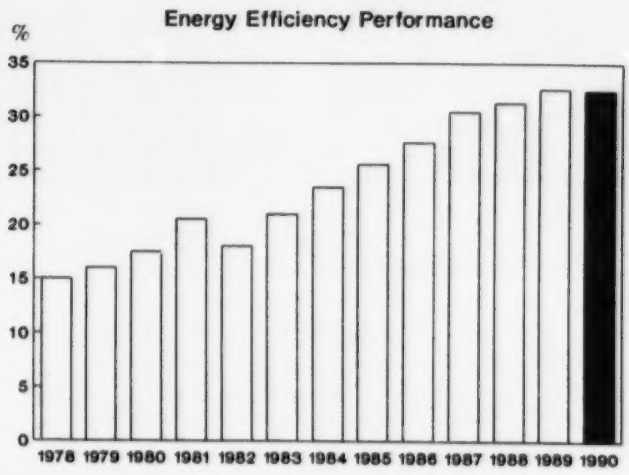
Energy Consumption & Carbon Dioxide Emissions

Type	Quantity	Terajoules	Percent	CO_2 emissions Tonnes	Percent
Natural Gas	624,193,992 m3	23,220	16.2	1,153,570	15.5
Electricity	13,570,627 MWh	48,854	34.1	1,967,029	26.5
Petroleum Products:					
Distillate Oil	27,564,355 litres	1,075	0.8	78,593	1.1
Residual Oil	306,808,459 litres	12,676	8.8	906,841	12.2
Diesel	27,564,355 litres	11,594	8.1	819,580	11.0
Gasoline	15,088,692 litre	546	0.4	37,117	0.5
Coal	247,788 tonnes	7,954	5.5	732,563	9.9
Coke	245,021 tonnes	5,709	4.0	539,044	7.3
LPGs	750,587,174 litres	19,968	13.9	1,194,885	16.1
Others (steam, water)	n/a	11,756	8.2	n/a	
Totals		143,352	100.0	429,223	100.0

Petroleum Refining Industry

Energy Conservation Task Force

Kerry A. Mattila
Chairman



Introduction

This report is based on submissions from seven companies which process about 85% of the crude oil upgraded and refined in Canada.

Major operating changes in the industry since 1972 have made it necessary to adopt a more recent base year to accurately quantify progress in energy efficiency. As a result, 1985 is now used as the common reference year. For statistical continuity, annual changes in performance since 1985 have been added to the 25.6% gain previously reported.

Energy Efficiency Improvement

In 1990, the petroleum refining industry experienced a marginal loss of energy efficiency by dropping 0.1% during the year. The net gain from 1985 is 6.86% while the overall improvement is 32.5% better than comparable 1972 base year operating conditions.

The minor decline resulted from the combined effects of refinery revisions to compensate for tetraethylead phase-out and lower throughputs caused by the economic recession. Without any processing adjustments to equate to 1985 operating conditions, the gain would have been 9.5%. The 30% improvement target that was set 5 years ago was surpassed in 1988.

Almost all of the major energy conservation projects arising from process studies conducted through the 1980s have been completed. Few new major capital projects are planned for implementation in the near future. Recent instability of crude oil and product prices resulting from the Gulf war are continuing to complicate investment decisions regarding energy conservation and other projects.

Falling product demand has also put a further strain on investment capital for energy efficiency projects. No significant new investment is anticipated until the market for petroleum products recovers.

However, any additional processing equipment needed to meet new government processing or environmental regulations will be designed with the highest possible energy efficiencies. It is anticipated that many of these projects will consume additional fuels and electricity and take a significant amount of the available funding normally spent on efficiency related projects.

Operations and Maintenance

Previous CIPEC reports have described numerous energy conservation improvments. Despite the instability experienced by the petroleum refining industry in 1990, energy managers have nevertheless concentrated on the following activities:

- Closer analysis and attention to process settings;
- Increased direct responsibility for achieving conservation goals assigned to operators and maintenance workers;
- Emphasis on training of operators and technical staff;
- Continued commitment to timely repair of steam leaks, damaged insulation, steam traps, etc., and to heat exchanger cleaning;
- Optimization of steam systems;
- Improvements in energy monitoring and control techniques;
- Application of process optimization techniques.

Capital Projects

Less capital investment in energy efficiency occurred in 1990 than previous years. However, the main emphasis of investment was on improvement of process control systems and steam reduction.

Technology Improvements

Recent gains in energy efficiency have come partly through application of the latest advances in processing technology. Now, the industry has a strong interest in certain R&D improvements being developed throughout the world. The most promising of these developments include:

- Improved catalysts and additives;
- Techniques to reduce crude oil and product losses;
- New equipment designs to increase heat recovery;
- New techniques to convert gas components into process liquids;
- Advanced computer control and process optimization techniques;
- Sophisticated data acquisition and management systems;
- Applications for high efficiency electric motors and drives;
- Advanced equipment for monitoring and control of electrical power;
- New types of on-line liquid and gas stream analyzers;
- Flare gas measurement and recovery techniques.

Task Force Activities

When the Petroleum Refining Industry Task Force was first established in April 1977 it consisted of separate Steering and Technical Committees to handle the policy and technical related work. The independent Petroleum Association for Conservation of the Candian Environment (PACE) organization was used to consolidate and maintain the confidentiality of the industry's operating data.

These functions have now combined within the Canadian Petroleum Products Institute (CPPI) and are administered at its own expense.

Future Outlook

The flat performance experienced in 1990 is unlikely to improve in 1991 as forecast reductions in product demand will have a continuing impact. Efficiency should rebound when the economy emerges from the recession, but a full recovery is not expected until early 1992.

Continuing instability in product markets and corresponding losses in profitability will make investment capital extremely scarce. As well, continuing changes to product specifications, such as the expected introduction of low-sulphur diesel fuel, will require new processing facilities. While these will be designed to include all practical efficiencies, overall energy consumption per unit of output is expected to increase. It is therefore very difficult to foresee a return to the 1989 peak efficiency for some time.

Table I

Performance Calculations

Current Year Total Energy Input	318.6 petajoules
Equivalent Base Year (1985) Energy	313.9 petajoules
Adjustments (See Table II)	26.2 petajoules
Gross Improvement (1985 - 1990)	9.46%
Net Improvement (1985 - 1990)	6.86%
Net Changes 1972 -1985	25.6%
1986	2.0%
1987	2.9%
1988	0.8%
1989	1.3%
1990	-0.1%
Total	32.5%

Table II

Processing Adjustments

Total measured energy consumption rate	3691.3
Processing Adjustment*	114.4
Lead phase-out and higher Mogas Octane	27.4
Increased desulphurization	1.0
Product mix changes	-0.7
Other processing adjustments	104.3
Major capacity additions	-30.7
Reprocessing of wastes	N/A
Throughput Effect	-6.5
Miscellaneous	94.7
Total Adjustments (line 2-10)	304.0
Current Operations Adjusted to B.Y. conditions	3387.4
Base Year (1985) Actual Energy Consumption	3636.1
Energy conserved (line 13 minus 12)	248.7
Percent change from Base Year (1985)	6.86
Total Refinery Input (1985)	198,100 m^3/day
Total Refinery Input (1990)	236,500 m^3/day

* Calculated on Nelson Complexity Index of 498 MJ/m^3 of throughput.

Table III

Consolidated Energy Use

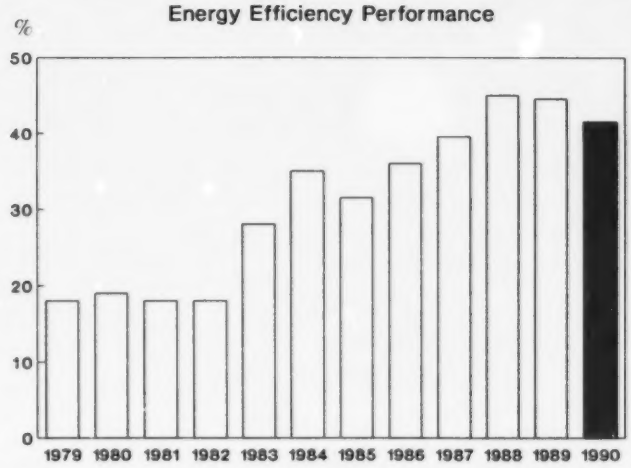
Type	Units	Quantity	Energy (PJ)	Percent
Natural Gas	m^3	1,186,020	45.55	14.3
Electricity*	MWh	4,478,433	47.47	14.9
Residual Oil	m^3	588,00	6 24.53	7.7
Petroleum Coke	kg	1,718,966	60.21	18.9
Other Fuels				
LPG	m^3	83,792	2.23	0.7
Refinery Gas	m^3	3,696,81	45.55	42.8
Steam	kg	1,027,373	2.86	0.9
Total			318.6	

* Purchased electricity converted at gross 10.551 MJ/KWh rate.

Plastics Processing Industry

Energy Conservation Task Force

Chris LeClair
Chairman



Introduction

This survey covers 41% of the independent processors that make up about half of the $11 billion total plastics business in Canada. These results come from a variety of companies that use all manner of processing technologies. These include: extrusion, injection moulding, thermoforming, foam and blow moulding, and film making operations.

The survey does not include large resin makers, specialized compounders, distribution companies, equipment makers, or those processors that are an integral part of other manufacturing industries such as automotive and electrical.

Energy costs in the surveyed companies range from $2.7 million down to $30,000. Eighty percent of the firms had energy costs above $200,000.

Energy Performance

The general business recession that started last year had a large impact on this year's energy utilization. After performance slipped 0.4% in 1989, a further decline of 2.9% occurred in 1990 as a result of a 6.6% drop in production which resulted in an 8% decline in capacity utilization. Several companies in the survey reported capacity usage down by 20% or more. The peak energy utilization occurred in 1988 as a result of capacity rates reaching 100% in late 1987 and carrying through 1988.

The overall gain of 41% consequently fell short of the 1990 goal of 50% because of this year's negative results.

Energy utilization has gone through three distinct phases in the plastics processing sector since monitoring began in 1979. The first four years of performance was relatively flat because energy conservation efforts were just getting started when the impact of the 1981-82 recession gave pause to the majority of improvements.

In the second phase between 1982 and 1988, the rapid annual performance increase of 4.6% per year was due to booming increases in production volumes, rising capacity rates and a steady investment in new machinery. Most all processors shared in this phenomenal growth. At the end of this growth period management then found it necessary to rapidly shift its focus more to productivity issues because of rising international competition.

In some cases companies were merged to strengthen their financial and technical capabilities. Businesses were often streamlined to optimize production on selected products which required specialized equipment. Sophisticated new computerized controls were added. Mold changing techniques were steadily improved to shorten time lost between production runs. Extrusion flow problems were the focus of attention and helped with new mold designs and experimentation with new gas injection techniques.

However, even though most of the equipment makers were offering high efficiency motors and other enhanced energy conservation features such as dual extrusion screws, variable speed hydraulic pumps, etc., processors were somewhat reluctant to use these new features because of the additional capital expense and specialized personnel training involved for operation and maintenance.

But the plastics processing industry is a good example of the close technological cooperation existing

between equipment makers and end-users. Equipment suppliers are now working more closely with their customers by offering special training courses to teach operators how to get the most out of the newest equipment. As well, equipment makers are simplifying their controls to make complex machines easier to operate.

For example, programmable controls have been trimmed down to the bare essentials with visible menu screens made more user friendly. Artificial Intelligence (AI) systems now exist that automatically adjust operating conditions during each machine cycle to minimize production losses and scrap.

Even with all these improvements, however, Canadian companies are still slower than European and Japanese firms to introduce the newest enhancements because of the less favourable Canadian tax structure and higher borrowing cost of capital.

It is unlikely that future performance increases will return to the high rates seen between 1982 and 1988. Slower rates of production growth are forecast because of the sooner-than-expected competition from international companies, the shift of some industrial customers to the U.S. and Mexico, and the slow down in the rate of substitution of plastics for other traditional materials.

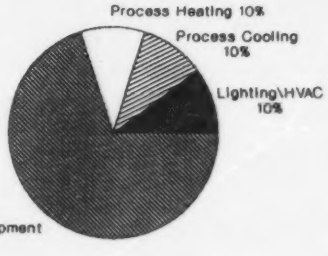
New environmental restrictions on final disposal of plastics may also effect future production rates. The Canadian Plastics Institute and Ontario Hydro have therefore decided to conduct a major study into the current state of the industry's equipment, technology penetration, viable opportunities and common barriers to future conservation. Even though three-quarters of the industry is located in Ontario, the study is expected to benefit all processors in the other provinces.

Energy Use Patterns

The combined share of electricity has risen from 40% in 1979 to 44% in 1990. This is due generally to a larger concentration of the industry in Ontario where larger plants can be run more continously. Special incentives offered by Hydro Quebec have resulted in some plants using only electricity.

Figure 2 shows the general results of a survey by Ontario Hydro of where electricity is used in the plastics industry.

Figure 2



Energy use in the various processing operations is significantly different, however, because of the nature of the processes and the equipment used. For example, electricity often provides between 80% to 90% of the total energy in extrusion and injection molding operations. This amount varies somewhat depending on the machine clamping capacities, resins extruded, continuity of production schedules and the size of resin heaters used to compensate for the different extrusion pressures.

Custom shops often see electricity shares from 20% to 70% because of the greater amount of machine idle time and supplemental factory heating and ventilation.

The share of electricity use in film making can also be as high as 90% because of the elaborate resin heating systems and film cooling equipment. Much of the recovered heat from the process is used to heat the factories, which lessens the need for fossil fuels. Electrical energy intensities for film making (about 14 GJ/kg) are sometimes twice that of the less intensive blow molding and plastics coating processes.

The electricity share in the plastics coating and thermoforming processes are in the 25% to 30% range. In this case it is used primarily for motors on materials handling equipment and for other plant utilities.

Most plastics processing operations are exothermic, which require extensive cooling towers to exhaust the unusable surplus heat. Numerous studies exist on how best to recover rejected heat. The film making process appears to offer the best potential because of recent improvements in heat pump technology.

Table I

Energy Consumption and Trends

Type	Units	Terajoules	Percentage 1990	1985	1979
Electricity	381,729 MWhr	1,374.2	43.6	43.2	40.0
Natural Gas	46,138,311 m^3	1,716.3	54.4	47.2	55.5
Propane	396,691 Litres	10.5	0.3	0.2	0.6
Liquid Petroleum Products:					
Distillate Oil	763,874 litres	29.8	0.9	1.1	1.0
Residual Oil	68,173 litres	2.7	0.1	1.6	3.5
Diesel	350,307 litres	13.9	0.4	0.3	0.1
Gasoline	130,558 litres	4.7	0.2	0.3	0.1
Total		3,152.7			

Table II

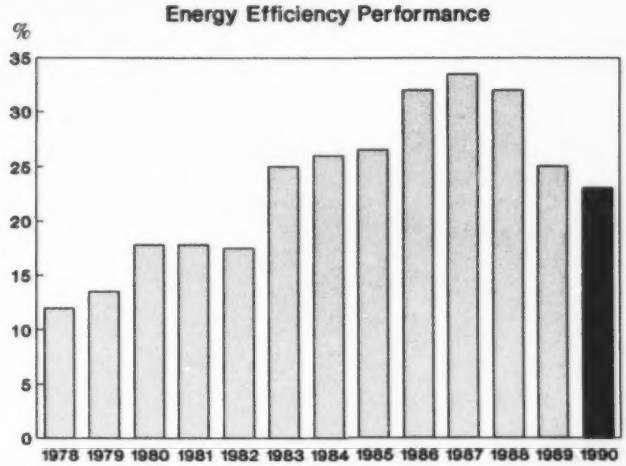
Energy Use and Efficiency

Current Year Total Energy Inputs:	3,152.7 Terajoules
Base year (1985) equivalent energy:	3,439.7 Terajoules
Efficiency Improvement 1980 to 1985 =	31.48 %
1986 =	4.35 %
1987 =	3.63 %
1988 =	5.49 %
1989 =	-0.41 %
1990 =	-2.94 %
Total	41.60 %

Pulp and Paper Industry

Energy Conservation Task Force

M.J. Frost
Chairman



Sector Description

The Canadian Pulp and Paper Association's Energy Monitoring Report covers 61 companies that operate 121 mills, accounting for about 95% of the total pulp, paper and paperboard produced in Canada in 1990. Five of the mills included in the report are not members of the association. A list of participating companies is appended.

Performance

Purchased energy per ton of product increased slightly during the year with the result that reduction in purchased energy since 1972 now represents 23.6% versus the industry's objective of a 33% reduction for the 1990 year.

The major source of purchased energy continues to be electricity which accounts for 36.8% of the total purchased energy. Heavy fuel oil is 27% of the total, which is 42% of the amount used on an equivalent production basis in 1972. Natural gas has increased to 31.8% of the total purchased energy.

The reduction in heavy fuel oil use is equivalent to 3.22 billion litres. The total purchased energy use is equivalent to 2.65 billion litres of heavy fuel oil when compared to the base year of 1972.

Operating Conditions

Shipments of pulp and paperboard for the year 1990 declined by 2.9% compared with 1989. Overall, the industry operated at 87% of capacity for the year.

Replacement of fossil fuels with wood wastes generated by the industry and neighbouring wood products operations declined slightly during the past year. These wood wastes now account for 63% of the total fuels consumed throughout the industry. Waste fuels plus captive hydraulic power now account for 52% of the energy used, up from 42% in 1972.

Technological Developments

The east angus Quebec mill of Cascades (East Angus) Inc. was awarded CPPA's Technical Section Energy Conservation Opportunity Award in 1990 for conversion to a biomass suspended firing system. To replace a large idle electric boiler, the company converted an old oil-fired boiler to use dried pulverized wood.

The total energy savings (oil versus wood), less system operation and maintenance costs, are estimated at $11.8 million per year. The cost of conversion was $5.6 million including modifications to the woodroom.

The B&W (Stirling) 100,000 lbs/hr was originally designed to fire pulverized coal in 1953. It was determined that suspension firing in this boiler could be successful. The new fuel source is sawmill waste dried to less than 10% moisture and pulverized to 1/16 inches for pneumatic conveying into the two suspension burners. These burners can now use three different fuels (oil/wood/gas). By using flue gas to dry the hog fuel the mill uses approximately 30% less fuel compared to undried fuels. No major modification was necessary on the boiler itself.

PAPRICAN's applied research program continues to include many projects that have significant energy conservation potential. Many of these projects develop new basic technological concepts that help improve energy management. Some examples of such projects are listed below:

Groundwood Control

New control systems are being developed for groundwood mills that allow production of pulps with improved quality while at the same time reducing energy input.

Status: Mill Trials.

Mechanical Pulping Control

Improved process control in mechanical pulping can also reduce both energy consumption and fluctuations in pulp quality. These techniques require sophisticated on-line measurement and control of consistency of chip and pulp production.

Status: Mill Trials

Energy and Refining Intensity Split

Thermomechanical pulp is usually produced with two refiners operating in series. There is experimental evidence that shows specific energy can be reduced and pulp quality improved through optimization of the two stages. Refining intensity depends on:

a) rotational speed

b) type of refiner

c) refining consistency

d) plate pattern

Status: Tested in pilot plant.

Interstage Peroxide Brightening in TMP Systems

Treating thermomechanical pulp with caustic and hydrogen peroxide after the first stage of refining brightens pulp and softens the fibres and fibre bundles. This fibre softening makes possible:

- a 20-40% reduction in energy input with the same pulp strength and production rate.
- a 20-40% increase in production with the same pulp strength and energy input.
- or any combination of the above effects.

It also uncouples the operation of the second stage refiners from the first stage to allow better distribution of the energy between the two stages.

Washing pulp at the interstage process gives a lower volume of concentrated effluent that requires less equipment investment than required for combined mill and paper machine effluents. Anaerobic treatment is particularly attractive for this concentrated stream.

Status: Mill trial, pilot plant.

Impulse Drying

Improved water removal rates in single felted presses can be obtained by simultaneous application of high temperatures and mechanical pressure on the web at the hot metal rolls. The higher solids content after impulse drying also saves steam heat in subsequent drying operations. Impulse drying appears at this time to be applicable mainly to lighter paper grades (basis weight under 75 g/m^2). Delamination problems encountered with heavier grades being eliminated.

Status: Pilot plant.

Table I

Energy Efficiency Improvement

Current Year (1990) Total Energy Inputs	349.92 petajoules
Base Year (1972) Equivalent Energy Inputs	457.84 petajoules
Net Improvement(1972 - 1990)	23.6%
Adjustments - None	
Actual Base Year Consumption	352.62 petajoules
Current Year Production	24,718,975 tonnes
Base Year (1972) Production	19,037,824 tonnes

Table II

Energy Use and Trends

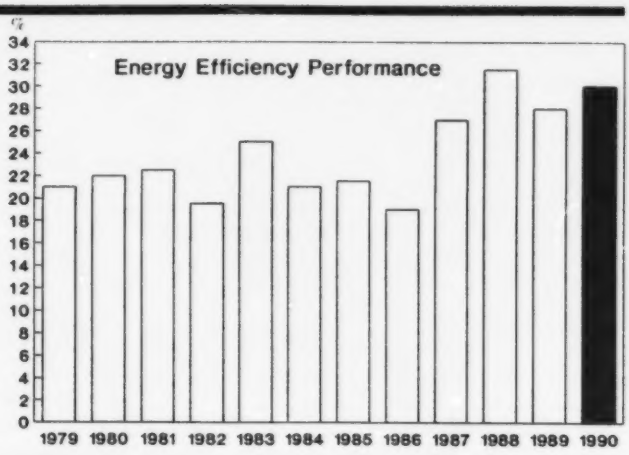
Type	1972* petajoules	Percent of Total	1989** petajoules	Percent of Total	1990** petajoules	Percent of Total
Coal	15.64	3.4	4.11	1.2	4.58	1.3
Petroleum Products						
Residual Oil	225.33	49.2	105.91	30.1	94.59	27.0
Distillates	7.99	1.8	4.83	1.4	4.08	1.2
Natural Gas	92.22	20.2	103.96	29.5	111.34	31.8
L.P.G.	1.01	0.2	0.81	0.2	1.04	0.3
Other	4.76	1.0	3.27	0.9	5.46	1.6
Electricity	110.89	24.2	129.42***	36.7	128.85****	36.8
	457.84	100.0	352.31	100.0	349.92	100.0

*Base Year volume equivalents.
**Actual use
***3.18 petajoules (2.5%) used in electric boilers.
****1.89 petajoules (1.5%) used in electric boilers.

Textile Industry

Energy Management Task Force

J. Guy Morin
Chairman



Introduction

The textile industry in Canada is complex and diverse. It is an industry that is as old as man and modern enough to produce space-age materials.

The textile industry includes producers of man-made fibres; producers of yarns and fabrics; producers of consumer and industrial textiles; plus firms that dye and finish textile yarns and fabrics.

Its products are used in agriculture, apparel, construction, defence, the production of many industrial goods, environmental protection, transportation, packaging and health care.

The Energy Management Task Force of the Canadian Textiles Institute represents companies accounting for more than 90% of textile production in Canada.

The textile industry is technologically innovative and larger than it has ever been. It has survived and prospered due to a high rate of capital investment and the increasing emphasis that is being placed on training.

Historically, recessions have a more severe impact on textile manufacturing than other sectors. This has been true for the 1989-1990 recession although, on average, the impact on textiles has not been as severe as in 1982.

Despite a high Canadian dollar and a recession, textile exports to the United States increased by 29% in 1990 or by $129 million. Textile exports to all countries rose by 18% to just under $1 billion.

Textile industry shipments in 1990 were $6.2 billion making last year the fourth largest in the industry's history. The all-time record was set in 1988, when shipments reached $6.7 billion.

Total Canadian textile investments in 1990 were $515 million, which sets a new annual record. Investments during the 1980s exceed $3.6 billion. Investment intentions for 1991 are down slightly, but if the forecast is met, 1991 will be the second largest investment year in the industry's history.

1990 Performance

With a net energy efficiency improvement of 1.5% in 1990, the textile industry came within 1.2% of reaching the 1990 target of a energy efficiency gain of 31%.

Since 1974, this makes for an overall gain of 29.8%.

Textile energy improvement in 1990 results from the record levels of capital investment in the industry. Textile efficiency largely depends on capacity utilization and any gain during a recession marks a major step forward.

Task Force Activities

A number of factors limited Task Force activities in 1990. These included uncertainty over CIPEC's budget and future focus; the need for managers to devote their attention to surviving the recession; and the availability of relatively stable and cheap energy supplies.

Within this context, Task Force activities have been limited to gathering energy data and to analyzing how best to reorganize textile energy activities.

Much thought has been given to improving textile energy efficiency in the coming years. Textile mills use large amounts of energy to produce material. This energy is usually provided by steam which originates at a central boiler. The Task Force is considering

placing the emphasis on how to reduce the size of these boiler systems through the use of new technology based on dedicated application energy sources.

The following case history is an example of this technology in action.

Case History

Traditionally, energy efficiency gains have been achieved by decreases in the amount of energy that it takes to produce a kilo of product. Another way of achieving energy efficiency gains is through increased productivity. In the following case history, the same amount of energy used before the installation of new equipment is able to produce increased volume.

This case history also represents what may be believed to be the best way to produce energy gains for the future, the removal of specific operations from a central boiler and firing or heating of these operations through dedicated power sources.

Boiler system decentralization provides greatly reduced steam losses. Reducing the capacity of steam plants, in some cases, may also reduce the need for supervisory personnel.

In this case, a carpet company wanted to increase its dryer productivity by 15% and solve humidity problems created by poor air distribution. The dryer was heated by steam coils connected to a central steam system.

After an extensive analysis which included comparing the merits of both infrared and direct fired technologies, the company chose three direct-fired gas model 400 Ovenpak, Maxon burners to replace the steam coils.

Including installation, the cost came to $85,000. The work took less than ten days. There were no production losses because the work was performed during vacation. The capital investment was recovered through greater productivity in eight months.

While not all of the humidity problems were solved, the increased productivity target of 15% was exceeded. On lighter materials increased productivity has reached 40%. On heavier materials the increase was 20%. The average increase was 25%.

This example also illustrates the growing tendency to lock energy gains into improved quality and productivity.

Energy Use Patterns

There were virtually no changes in energy use patterns in the textile industry during 1990. While minor changes in the use of some energy forms did occur, the changes accounted for less than 2% of each category. These changes are too small to form the basis of any predictions or to warrant detailed explanation. They can best be described as resulting from the random installation of new or replacement machinery necessitating energy source changes.

Future Outlook and Concerns

The traditional image of textile manufacturing as a declining sector no longer reflects reality. New records in shipments, investments, and exports are characteristic of a dynamic industry.

Textile manufacturing has become a major user of high technology, a provider of fewer but higher quality jobs, with rapidly growing productivity, and better than average profitability.

The industry has committed itself to innovation, change and long term participation in the evolving global trade and economic environment. Its objective is to continue to improve its international competitiveness and already substantial contribution to Canada's economic, technological, social and environmental well-being. It plans to do this in active partnership with its employees, customers, suppliers and government.

Its goal is to compete in the Canada-US free trade area from a Canadian base.

The key to its future success is continued and increased investment in technology and human resources.

Effective energy management will continue to occupy an important place in future developments. Every cost saving improves competitiveness; more efficient use of energy is a mark of good corporate citizenship; and as the Gulf War reminded us, complacency about security of future supply is unwise.

The Textile Energy Management Task Force and its activities remain an important priority for the industry.

Table I

Energy Efficiency Improvement

Current year (1990) total energy inputs	6,875,794 gigajoules
New base year(1985) equivalent energy inputs	6,980,690 gigajoules

Net Improvement over base year= 1.5%

Adjustments = None

Total efficiency gain from 1974 to 1990 = 29.8%

Table II

Energy Use

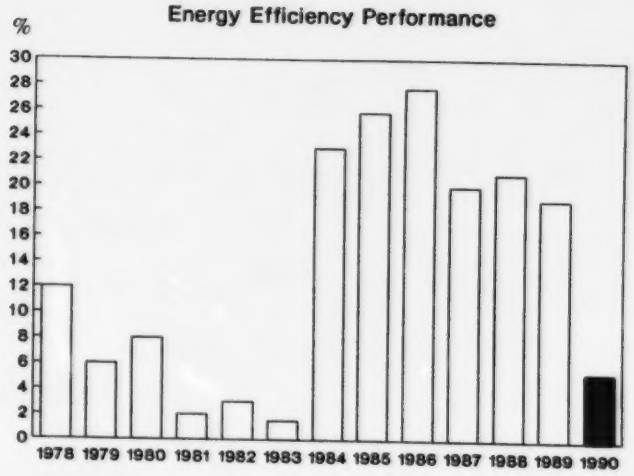
1990

Type	Units	Gigajoules	Percentage of Total Consumed 1990	1889
Natural Gas	104,021,000 m^3	3,869,581	56.3	57.6
Electricity	562,952 MWh	2,026,628	29.5	28.1
Liquid Petroleum Products				
Residual Oil	21,353 kilolitres	903,232	13.1	11.8
Distillate Oil	142 kilolitres	5,538	0.1	0.1
Diesel & Gasoline	226 kilolitres	8,611	0.1	1.8
LPG	2,338 m^3	62,204	0.9	0.6
Total 1990		6,875,794	100	100

Transportation Industry

(MANUFACTURING)

Ken Rossi
Chairman



Introduction

The Transportation Industry (Manufacturing) Task Force draws its membership from the following six trade associations:

- Aerospace Industries Association of Canada (AIAC)
- Allied Boating Association of Canada (ABAC)
- Automotive Parts Manufacturers' Association (APMA)
- Canadian Marine Industries Association (CMIA)
- Canadian Truck and Trailer Manufacturers' Association (CTTMA)
- Motor Vehicle Manufacturers' Association (MVMA)

Of the 571 total companies, 63 reported their individual consumption and performance results in 1990. About 75% of the total industry's energy use is represented in this report.

The 1990 survey trends reflect the performance in a very diverse group of large and small companies. About 71% of the reported consumption was used by the 3 large MVMA companies, 17% by the 32 APMA companies, and 12% by 28 diversified members of the AIAC, ABAC, CMIA, and CTTMA sectors.

Response to this year's survey was noticeably reduced because of the effects of the general business recession and changing composition of the industry. There have been many plant closures as a result of companies moving operations back to the U.S. or to Mexico. Survey response has shrunk back to 1988 levels as a result of 24 fewer companies reporting in 1990. APMA and AIAC participation is down by 12 and 5 respectively, and fewer by 7 in the other sectors. The reduced level of participation has also shifted the percentages of energy used in the dominant APMA sector.

Performance

Combined performance in 1990 declined by 2.6% which continued the downward trend experienced since the peak years in 1985-86. Energy consumption per unit of production is 16.8% less than it was 5 years ago.

Monitoring energy utilization in the transportation manufacturing industry is very difficult because of the unusual complexity of identifying "units of production". In the early days of monitoring, dollar value-of-shipments were used. But that system proved unworkable because of undue problems with conversion factors and timing of access to Statistics Canada's industry data. Today, units of production are counted as: automobile, engines, tonnes of iron poured, etc. Even so, an automobile, for example, is not the same as it was in 1985 nor in the early 1970s when monitoring began. Performances must therefore be measured relative to each previous years' and combined only for trend analysis.

Results displayed in the above graph, however, show that energy utilization is directly affected by

changes in production volumes, which have declined more rapidly since 1985 than before the 1982-83 recession.

Because of low product demand, only two-thirds of the output capacity was being used in 1990. Output was a full 12% below 1989's and 22% lower than 1985 peak rates. Results were aggravated by the negative trends in the dominant MVMA and APMA sectors where several of the large companies were operating at only 30% to 40% of 1985 production rates. These two sectors account for 88% of the total energy consumption and impact on performance.

In spite of these negative results, however, energy conservation will remain an important factor in company productivity improvement campaigns because of the need to control manufacturing costs.

Sector Performances

ABAC (Boating) and CTTMA (Truck/trailer)

Energy use by the companies in these two industry associations represents about 1% of the total surveyed. Performance, although negative, does not have a noticeable impact on the task force total results.

Nonetheless, participation of these two associations continues to be important since it provides a broader perspective on the industry's operating conditions and concerns.

AIAC (Aerospace)

The 22 reporting companies in this sector show overall efficiency 6.5% better than the 1985 reference values.

Higher levels of performance have been reported in the past but some reductions have resulted from major environmental retrofits. These were required to improve plant safety and health standards.

This sector's performance history is also different from the other sectors' because its production volumes are geared more to special market demands. Long-term contracts also help cushion the sharp fluctuations felt by other equipment manufacturing sectors.

APMA (Auto Parts)

In spite of consistent gains in previous years, performance turned sharply downward in 1990 with a negative 26% amount. The cause is thought to be due more to changes in the reporting base rather than reductions in companies' performances.

This sector continues to be challenged with fierce competition from offshore and Mexican operations and has noticeably suffered from many closures and relocations.

In spite of the tough economic times, many of the surveyed companies are planning new conservation measures to help improve productivity and competitiveness.

CMIA (Shipbuilding)

Energy consumption in the 4 reporting companies fluctuates widely from year to year because of the unsteady production volumes and an uncertain future business. However, energy use per unit of output is now 29% above 1985 standards.

MVMA (Motor Vehicles)

Energy efficiency dropped to a negative 16.8% position relative to 1985 reference year.

Lower capacity utilization is the major factor producing this disappointing trend. Some large companies are operating at 35% of 1985's production levels.

Nonetheless, conservation actions continued to be implemented in 1990 even though severe restrictions had been placed on capital and maintenance budgets.

The experimental solar-wall retrofit installed at the Ford Motor Company of Canada Ltd., Oakville site is proving to be a valuable installation and is spawning many installations in automotive and aircraft facilities. The accompanying monitoring system installed on this retrofit under a joint Federal/Provincial initiative is also providing valuable design information on similar solar applications.

Energy Use Patterns

Even though the reporting base has changed substantially, the electricity share is rising because of continued factory automation. As shown in Table I the electricity share has climbed at a rate of 2.6% per year up to the 33% level. However, this situation is being monitored carefully because of the rapidly es-

calating costs and potential for shortages in the near future.

Natural gas is by far the dominant fuel because of its lower cost and cleanliness of use. The small quantities of fuel oil used are required to satisfy interruptible natural gas contract conditions.

Coke continues to be a vital source of energy in the MVMA and APMA member companies foundry operations with a steady 5% to 6% share during the past ten years.

Task Force Activities

In spite of member companies' tight budgets and manpower constraints, the Transportation task force continues its mission with monthly meetings and delivery of technology transfer seminars. For this purpose, the task force includes representatives from Energy, Mines and Resources Canada, the Ontario Ministry of Energy and Ontario Hydro who help finance periodic seminars, such as the 'Energy Savings Today' presentation in September.

The highly successful IDEA EXCHANGE newsletters also continue to provide useful information on energy-related programs.

Future Outlook and Concerns

The task force's mission in the past has concentrated on promotion of energy efficiency for the purpose of cost reduction. This mission must now be broadened to include energy's environmental effects. However, energy efficiency is still viewed as the central issue that needs the primary attention. The voluntary CIPEC organization is therefore seen as the most effective way for government and industry to cooperate in this vital endeavour.

Any expanded or revised monitoring system used to measure changes in energy efficiency and environmental emissions will require very careful consideration. For instance, any thoughts of changing the widely accepted "energy per units of production" measure back to a more obscure GDP reference base would not be acceptable in this sector. This economic-related basis was tried before and didn't work. Manufacturing companies need specific production information for performance comparisons and effective quality control.

As well, the choice of a new base reference year might also require careful study. For example, energy efficiency comparison between the 1985 boom year and present 1990 recession was untimely for the Transportation Industry Task Force and resulted in an apparently distorted performance picture. The negative result is thought to be largely because of drastic changes in members' businesses and products rather than less efficient use of energy. A similar situation that would question the credibility of results would be unfortunate.

There is also a need to carefully examine the cost of installing environmental improvement projects, particularly when many companies are faced with mounting international competition and loss of business. Environmental solutions are often expensive to implement and use additional energy to operate. A comprehensive analysis is required.

Table I

Energy Efficiency Improvement

Current year (1990) total energy inputs		43,476,662 gigajoules
Base year (1985) equivalent energy inputs		37,223,170 gigajoules
Net Improvement	-16.8%	
Efficiency gains 1978-1985		25.6%
1986		2.1
1987		-5.4
1988		-4.9
1989		-6.0
1990		-2.6
Total		8.8

Table II

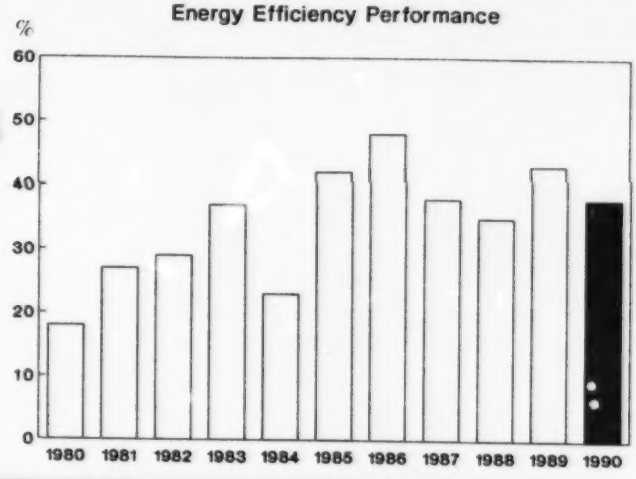
Transportation Industry (Mfg.)

	Quantity			Percentage Trends									
Type	**Units**		**Gigajoules**	**1990**	**1989**	**1988**	**1987**	**1986**	**1985**	**1984**	**1983**	**1982**	**1981**
Natural	23,804,155	m^3	23,804,155	54.7	60.4	57.9	56..7	55.7	54.7	54.5	52.1	53.0	50.9
Electricity	4,077,488	MWh	14,678,955	33.7	28.2	31.5	32.8	30.7	30.1	29.3	28.4	26.9	26.6
Liquid Petroleum Products													
Distillate Oil	5,474,975	litres	213,945	0.5	1.0	1.2	0.6	1.3	1.2	1.2	1.4	1.8	1.4
Crude Oil		n/a	–	–	–	–	–	0.2	–	–	–	–	–
Residual Oil	17,803,147	litres	721,027	1.7	2.2	1.6	1.7	1.8	2.1	3.6	6.3	7.5	10.6
Gasoline	567,198	litres	20,533	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.5	0.2
Diesel	830,092	litres	33,121	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.2	0.4	0.1
Turbine Fuel	13,959,176	litres	139,306	0.3	0.2	–	–	–	–	–	–	–	–
Coal	43,668	tonnes	1,187,333	2.7	1.8	1.8	2.2	3.5	3.5	3.8	4.0	3.9	4.7
Coke	85,449	tonnes	2,581,426	5.9	5.5	5.3	5.5	6.1	7.5	7.3	7.2	5.6	5.4
Other Fuels:													
Propane	3,504,856	litres	93,229	0.2	0.4	0.4	0.2	0.5	0.6	0.3	0.3	0.4	0.2
LP	131,027	litres	3,552	0.1	0.1	0.1	0.1	–	–	–	–	–	–
Total			43,476,662										

Wood Products Industry (Western)

Energy Conservation Task Force

R. C. (Dick) Bryan
Chairman



Task Force Description

The Wood Products Industry (Western) Task Force was formed by the Council of Forest Industries of British Columbia (COFI) in 1978 and represents 80 companies with more than 100 sawmills and 15 plywood and veneer mills. COFI members and affiliates account for more than 90% of the total product value of the forest industries in B.C.

Most mills in western Canada are members of industry trade associations which actively pursue a wide variety of business issues of common interest. In British Columbia, the major forest industry associations are the Council of Forest Industries of B.C., its Northern Interior Lumber Sector (NILS), the Caribou Lumber Manufacturers' Association (CLMA) and the Interior Lumber Manufacturers' Association (ILMA). CLMA and ILMA are also affiliate members of COFI.

This survey covers 53 operating sawmills owned by 20 companies, which account for 39% of the lumber produced in B.C. in 1990. The coverage in 1990 represents a reduction from the 1989 survey, which accounted for 47% of the B.C. production. The reporting sample covers mills of all sizes and represents all regions in B.C. as well as an Alberta sawmill.

Goals and Progress to Date

The industry's target for 1990 was a 7% overall increase in energy efficiency from the 1985 base year performance. This goal was achieved in 1989; unfortunately, the overall 1990 performance deteriorated significantly. The overall 1990 performance was 7.9% below that of the 1985 base year, but did represent a 38.8% improvement over the 1978 base year.

Average electrical energy consumption for the production of green lumber increased dramatically in terms of the 1985 base year; a significant deterioration from the energy performance registered in 1989. The 1990 performance, when compared to 1978, also represented a decline of 3.3%.

Compared to 1989, there was a decrease in the average efficiency of natural gas use in the kiln drying of lumber in 1990. When compared with the 1985 base year, however, there was an 7.6% improvement and a 57.8% gain when compared to the 1978 base year.

Lumber Industry Downturn

The lumber industry has not been healthy during the past three years. B.C. lumber production has declined each year since 1987. For the three years combined, on total sales of approximately $14 billion, the industry lost some $30 million (marginal profits in 1988 and 1989 were offset by a 1990 loss).

The losses were attributable to three factors: soft markets; a two to three fold increase in stumpage and other forest management charges; and a substantial and sustained rise in the value of the Canadian dollar vs. the U.S. dollar. The impacts of these negative influences have been felt throughout the industry and have resulted in production curtailments and layoffs, but relatively few outright plant closures.

Generally, sawmills in B.C. are designed to run at high volumes of output and relatively low unit costs. When volumes are curtailed, costs rise. Fixed costs, on a per unit of output basis, have risen by 11-40% with a majority of companies in the 20 to 40%

range. Variable cost elements have risen substantially as well.

Even though energy costs typically represent from one to four percent of manufacturing expenses, total production costs rose as high as 17% for many producers in 1990. About 60% of the producers are located in regions where low energy costs represent less than 3% of production expenses. In those companies, with more stable energy cost increases, the focus of attention was on the recession rather than energy conservation.

Improvements in electrical energy conservation performance have proven much more difficult to achieve than for natural gas. Conservation achievements in the use of natural gas have been due to the conversion of kiln-drying systems from natural gas to wood waste. As long as the sample of reporting mills remains similar from year-to-year, the natural gas conversion achievements are maintained. This is clearly not the case for electricity where conservation gains have been eroded in recent years.

Industry Outlook

The industry appears to be in the early stages of recovery in the second quarter of 1991. Markets have improved considerably. However, it is unlikely that without some decline in the value of the dollar and the introduction of a stumpage system which is sensitive to market conditions, that markets alone will be robust enough to return the industry to health. It is expected, however, that the current recovery will continue and strengthen in 1992.

Wood Products Industry (Western)

Energy Efficiency Improvement

Green Lumber	**1990**	**1985**	**1978**
Total sample production (10^6 board feet-MMFBM)	5482.6	5052.0	4202.2
Total electrical energy consumption (10^{12} J)	3097.3	2241.5	2297.7
Average electrical energy consumption (10^9 J per MFBM)	0.565	0.444	0.547
Current year total electrical energy inputs (10^{12} J)	3097.3	2241.0	2297.7
Comparison base year (1985) equivalent energy inputs (10^{12} J)		2432.6	
Comparison base year (1978) equivalent energy inputs (10^{12} J)		2997.8	
		Improvement (1985 base year) = -27.3%	
		Improvement (1978 base year) = -3.3%	

Kiln Dried Lumber			
Total sample production (10^6 board feet-MMFBM)	3937.43	159.4	1013.0
Total electrical energy consumption(mainly natural gas)(10^{12} J)	2800.6	2433.0	1708.8
Average electrical energy consumption (10^9 J per MFBM)	0.711	0.770	1.687
Current year total energy inputs (10^{12} J)	2800.6	2433.0	1708.8
Comparison base year (1985) equivalent energy inputs (10^{12} J)	3032.1		
Comparison base year (1978) equivalent energy inputs (10^{12} J)	6641.9		
	Improvement (1985 base year) = 7.6%		
	Improvement (1978 base year) = 57.8%		

Combined Energy Performance	**1990 Actual**	**1985 Equivalent**	**1978 Equivalent**
Total electrical energy consumption (Green Lumber)(10^{12} J)	3097.3	2432.6	2997.8
Total natural gas consumption (Kiln Dried 10^{12} J)	2800.6	3032.1	6641.9
Total sector energy consumption (10^{12} J)	5897.9	5464.7	9639.7
	Improvement (1985 base year) = -7.9%		
	Improvement (1978 base year) = 38.8%		

Reporting Companies

Chemicals

Allied Chemicals Canada Inc.
Ashland Chemicals
Atochem Canada Ltd.
BASF Canada Inc.
H. L. Blachford Ltd.
Carbochem Inc.
Canadian Oxy Chemicals
Celanese Canada Inc.
Cyanamid Canada Inc.
Dow Chemical Canada Inc.
DuPont Canada Inc.
Esso Chemicals Canada
Fiberglas Canada Inc.
General Chemical Canada Inc.
B. F. Goodrich Canada Inc.
Hercules Canada Inc.
Himont Canada Inc.
Kemtec Petrochemical Corp. Inc.
Lubrizol Canada Ltd.
Marsulex Inc.
Nitrochem Inc.
Novacor Chemicals Ltd.
Oxychem Canada Inc.
Pétromont Inc.
Polysar Rubber Corporation
Raylo Chemicals Ltd.
Reichhold Limited
Rhone Poulenc Specialty Chemicals
Rohm & Haas Canada Inc.
Shell Canada Chemical Company
Sulco Chemicals Limited
Surpass Chemicals Ltd.
The Alberta Gas Ethylene Company
Tioxide Canada Inc.
Union Carbide Canada Limited
Uniroyal Chemicals Inc.
Welland Chemicals Inc.
Witco Canada Inc.

Electrical and Electronic

3M Canada Inc
Alcan Wire and Cable Inc.
Alcatel Canada Wire Inc.
Andrew Canada Inc.
Ascolectic Ltd.
Camco Inc.
Commander Electrical Materials Inc.
Commander Electrical Equipment Inc.
Cooper Ind. (Canada) Inc. Belden Div.
Crouse Hinds Electric
Eaton Yale Ltd., Cutler-Hammer Industrial Controls
Edwards, a unit of General Signal Ltd.
Erico Canada Inc.
Ferranti-Packard Transformers Ltd.
Furnas Electric Company
Garrett Canada
Gennum Corporation
Gould Shawmut Company
Holophane Canada Inc.
Honeywell Ltd.
Iona Inc.
ITT Cannon
Klockner-Moeller Ltée.
Lincoln Electric Co. of Canada
MIL Tracy
Maloney Electric, Div. Hammond Hold Ltd.
Ouellet Canada Inc.
Philips Electronics Ltd.
Pyrotenax of Canada Ltd.
Reliance Electric Ltd.
Smith and Stone (1982) Inc.
Spar Aerospace Ltd.
Temco Electrical Products Company Inc.
Thomas & Betts Limited
Thomson Consumer Electronics Canada Inc.
Trench Electric
WCI Canada Inc.

Ferrous Metals

Algoma Steel Corporation
Dofasco Inc.
Sydney Steel Corporation

Food and Beverage

Bakeries

Ben's Limited
Corporate Foods Limited.
Eastern Bakeries Limited
McGavin Foods Limited
Multi-Marques Inc.
Weston Bakery

Biscuit Manufacturers

Christie Brown & Company Ltd.
Colonial Cookies Ltd.
Culinar Inc.
Interbake Foods Limited
Manning Biscuits Ltd.
Windsor Wafers Inc.

Breweries

Amstel Brewing Inc.
Labatt Breweries of Company Limited
Molson Breweries of Canada Limited
Moosehead Breweries Limited
Northern Breweries Ltd.
Pacific Western Brewing Co. Ltd
Upper Canada Brewing Co. Ltd.

Confectionery Manufacturers

Adams Brands Inc.
Ganong Brothers Ltd.
Hershey Canada (Montréal) Inc.
Kerr Bros. Limited
Leaf Confections Ltd.
Nestlé Enterprises Ltd.
Trebor Canada Inc.
William Neilson Ltd.
World's Finest Chocolate Inc.
Wrigley Canada Inc.

Distilleries

Alberta Distillers Limited
Canadian Mist Distillers Limited
FBM Distillery Co. Limited
Gilbey Canada Inc.
Hiram Walker & Sons Limited
Joseph E. Seagram & Sons, Limited
Palliser Distillers Limited

Food Processors

Best Foods Canada Inc.
Campbell Soup Company Ltd.
Hunt-Wesson Canada Ltd.
H.J.Heinz Company of Canada Ltd.
Kellogg Canada Inc.
Morrison Lamothe Inc.
Nabisco Brands Ltd.
Royal City Foods Ltd.
Snowcrest Packers Ltd.
Sun-Brite Canning Ltd.
Sunland Foods Ltd.
Sun-Rype Products Ltd.
Thomas Canning (Maidstone) Ltd.
Trebor Canada Inc.

Fisheries

British Columbia Packers Limited
Blue Water Seafoods Limited
Connors Bros., Limited
National Sea Products Limited

Grocery Products Manufacturers

Bovril Canada Inc.
Campbell Soup Company Ltd.
Canadian Home Products Ltd.
Corporation Delico Inc.
Culinar Inc.
General Foods Ltd.
Griffith Laboratories Inc.
Kellogg Canada Inc.
Kraft Ltd.
Lancia Bravo Foods Limited
McCormick Canada Inc.
Monarch Fine Foods Ltd.
Nabisco Brands Ltd.

Meat Processors

Burns Meats Inc.
Canada Packers Inc.
F. W. Fearman Company Ltd.
Intercontinental Packers Ltd.
J. M. Schneider Inc.
Piller Sausages & Delicatessens Ltd.
Quality Meat Packers Ltd.
Shopsy's Foods Ltd.
Vancouver Fancy Meats Co. Ltd.

Poultry and Egg Processors

Bexel, Division of Co-op. Fédérée de Québec.
Co-op Dorchester Ltée.
Lashbrook Produce Limited
Lilydale Co-op Limited.
Lilydale Poultry Sales (Victoria) Ltd.
Lucerne Foods Ltd.
Maple Lynn Foods Ltd.

Soft Drinks

Amalgamated Beverages Ltd.
Beverage Central Inc.
Beverages Lemoyne Ltée
Blackwood's Beverage Ltd.
Canada Dry Bottling
Coca-Cola Bottling
Gray Beverage Mfg. Ltd.
Gray Beverage Inc.
Kitchener Beverages Ltd.
Les Breuvages Deraspe Ltée
Northern Bottling Ltd.
Swift Current Bottlers Ltd.

Sugar Refineries

Atlantic Sugar Limited
British Columbia Sugar Refining Company Limited
Lantic Sugar Limited
Redpath Sugars Limited

Wineries

André's Wines Ltd.
Inniskillin Wines Inc.
Les Vins La Salle Inc.

General Manufacturing

Metal Processors

Aciers Slater Inc.
Bibby-Ste-Croix Foundries Ltd.
Brass Craft Canada Ltd.
Brown Foundry Ltd.
CAE Machinery Ltd.
Canada Forgings Inc.
Canadian Bronze Company Limited
C.M.Q.C. Usine de Bouletage
Cooper Tools Limited
Esco Ltd.
Founderies Magotteaux Canada Ltée
Gray Forgings & Stampings Limited
Hawker Siddley Canada Inc.
Jenkins Canada Limited
Kubota/Fahramet Inc.
Lake Ontario Steel Company Limited
Manville Canada Inc.
Magotteaux Canada S.C.C.
Snap-On Tools Ltd.
Teledyne Canada Metal Products Ltd.
The Canada Metal Company Limited
Western Foundry Co. Ltd.

Light Manufacturing

AWK Industrial Inc.
AAR-KEL Moulds Ltd.
Arm Industries Ltd.
Armstrong World Industries Canada Ltd.
Atco Industries Ltd.
Babco Inc.
Black and Decker Canada Inc.
Bombardier Inc.
Commercial Aluminum Ltd.
Dominion Controls Co. Ltd.
Ferro Industrial Products Inc.
Fasco Products, Div. of Indal
General Electric
Kawneer Company of Canada Limited
Kodak Canada Inc.
Merck Frosst Canada Inc.
NCR Canada Ltd.
Paddle Valley Products Limited
Stanley Acmetrack Ltd.
Tambrans Canada Inc.
Teledyne Canada Metal Products Limited
Trane Canada Limited

Processing Sector

Ashland Chemicals Inc.
Castrol Canada Inc.
Gates Canada Limited
General Tire Ltd.
Manville Canada Inc.
Michelin Tires (Canada) Ltd.
Trent Rubber Services Limited
Uniroyal-Goodrich Canada Ltd.
Merck Frosst Canada Inc.

Industrial Minerals

Abrasives

Exolon - Esk Co. of Canada Ltd.
General Abrasives - Abrasives Industries (Canada) Inc.
Norton Advanced Ceramics of Canada Inc.
Washington Mills Electro Minerals Corp.

Asbestos

Brinko Mining Ltd., Cassiar Division
JM Asbestos Inc.
Lab Chrysotile (Bell) Inc
Lab Chrysotile (Lac)
Lab Chrysotile (BC/KB/Normandie) Inc.

Cement

Canada Cement Lafarge Ltd.
Ciment Québec Inc.
Essroc Cement Limited
Federal White Cement Limited
Genstar Cement Limited
Miron Inc.
St. Lawrence Cement Inc.
St. Mary's Cement Company

Clay Brick and Tile

Briqueterie St-Laurent Ltée (Div of Jannock Ltée)
Canadian Vitrified Products Ltd.
Estevan Brick Ltd.
Hamilton Brick Ltd.
NSP (Div of NSP Inc.)
IXL Industries Ltd.

Concrete Products

Atlantic Industries Limited
Century Concrete Products Ltd.
Con-Force Structures Limited
Consolidated Concrete Products Ltd.
Doughty Concrete Products Ltd.
Downey Building Materials Ltd.
Genstar Materials Limited
Richvale Block & Ready-Mix (Div. of Lafarge Canada Inc.)
Redi-Mix Limited
York Block (Div. of Canada Cement Lafarge Ltd.)

Glass

AFG Glass Inc.
Consumers Packaging Inc.
Fiberglas Canada Inc.
Libbey St. Clair
PPG Canada Inc.

Lime

Havelock Lime Company of Canada Limited
Luzenac Inc.
Reiss Lime Company of Canada Limited
Summit Lime Works Limited
Stelco Steel

Miscellaneous Minerals

Falconbridge Ltd.
Indusmin Limited
3M Canada Inc.
Saskatchewan Minerals Ltd.
Steetley Talc Inc.

Refractories

A. P. Green Refractories (Canada) Limited
Canadian Refractories Limited
Clayburn Refractories Limited
Continental Refractories Company Limited
General Refractories Co. of Canada Ltd.
Manville Canada Inc.

Mining and Metallurgy

Canamax Resources Inc.
Cominco Ltd.
Denison Mines Inc.
Echo Bay Mines Ltd.
Equity Silver Mines Ltd.
Falconbridge Ltd.
Fording Coal Ltd.
Giant Yellowknife Mines Ltd.
Gibraltar Mines Ltd.
Hudson Bay Mining & Smelting Co. Ltd.
Inco Ltd.
Indusmin Ltd.
Iron Ore Company of Canada
Noranda Minerals Inc.
Central Canada Potash Co. Ltd.
Placer Dome Inc.
Quebec Cartier Mining Ltd.
Rio Algom Ltd.
Syncrude Canada Ltd.
Teck Corporation

Petroleum Refining

Consumers' Co-operative Refineries Ltd.
Esso Petroleum Canada
Petro-Canada Products Inc.
Shell Canada Limited
Suncor Inc.
Syncrude Canada Ltd.
Turbo Resources Limited
Ultramar Canada Inc.

Plastics

A. Schulman Ltd.
American Biltrite (Canada) Ltd.
Automotive Industries Ltd. (Donlee)
Beaver Plastics Limited
Bonar Plastics Ltd.
Borden Packaging and Industrial Limited
Burman-Castrol Canada Ltd.
Canada Cup Limited
Canadian General Tower Ltd.
Celfortec Inc.
Cyro/Chemacryl Plastics Limited
Coastal Plastics Limited
Cryovac/ W. R. Grace Co. Ltd.
Daymond, Div. of Redpath Industries Ltd.
Duron Plastics Ltd
Fabracan Inc.
F&H Plastics Ltd.
First Brands Ind. Corp.
Formica Canada Inc.
Horn Plastics Limited
IPL Inc.
Jet Moulding Compounds Ltd.
Les Plastiques Anchor Ltée.
LMG Reliance Inc.
Medallion Plastics Ltd.
Morbern Inc.
Pavaco Plastics Inc.
Pétromont Inc.
Plasti-Drain Ltée.
Plasco Manufacturing Ltd.

Plasti-Fab Ltd.
Plastiques Cascades Inc.
Polytainers Inc.
Polypenco Inc.
Reinforced Plastics Systems Ltd.
Relmech Manufacturing Ltd.
Rohm & Haas Inc.
Rubbermaid Canada Inc.
Roll-O-Sheets Canada Limited
Scepter Manufacturing Co. Ltd.
Shaw Industries Ltd.
Schlegel Canada Inc.
Tupperware Company Inc.
Union Carbide Performance Plastics Ltd.
Uniplast Industries Ltd.
Vanguard Plastics Ltd.
Waltec Plastics Limited

Pulp and Paper

Abitibi-Price Inc.
Armstrong World Industries Inc.
Atlantic Packaging Products Ltd.
Beaver Wood Fibre Co. Ltd.
Boise Cascade Canada Ltd.
Bowater Mersey Paper Co. Ltd.
Canadian Forest Products Ltd.
Canadian Pacific Forest Products Limited
Cariboo Pulp and Paper Company
Papier Cascades (Cabano) Inc.
Cascades (East Angus) Inc.
Cascades (Jonquière) Inc.
Calgar Pulp Company
Corner Brook Pulp & Paper Ltd.
Crestbrook Forest Industries Ltd.
Diashowa Inc.
Domtar Inc.
Donohue Inc.
Donohue Normick Inc.
Donohue St. Félicien Inc.
E.B. Eddy Forest Products Ltd.
Eurocan Pulp & Paper Co. Ltd.
Fletcher Challenge Canada Ltd.
J. Ford & Company Ltd.
Fraser Inc.
Gaspesia Pulp & Paper Co. Ltd.
Howe Sound Pulp & Paper Ltd.
Irving Pulp & Paper Ltd.
Island Paper Mills Company
James River-Marathon Ltd.
Kruger Inc.
James Maclaren Industries Inc.
MacMillan Bloedel Limited
Malette Kraft Pulp & Power Inc.
Minas Basin Pulp & Power Company Ltd.
Miramichi Pulp & Paper Inc.
NBIP Forest Products Inc.
Noranda Forest Recycled Papers
Northwood Pulp and Timber Ltd.
Paperboard Industries Corp.
Perkins Papers Ltd.
Procter & Gamble Inc.
Quebec & Ontario Paper Co. Ltd.
Repap Manitoba Inc.
Rolland Inc.
Rothesay Paper Ltd.
St. Anne-Nackawic Pulp & Paper Company Ltd.
St. Marys Paper Inc.
Scott Maritimes Ltd.
Scott Paper Limited
Skeena Cellulose Inc.
F.F. Soucy Inc.
Sonoco Limited
Spruce Falls Power & Paper Company Ltd.
Stone-Consolidated Inc.
Stora Forest Industries Limited
Strathcona Paper Co.
Tembec Inc.
Weldwood of Canada Ltd.
Western Pulp Limited Partnership
Weyerhaueser Canada Ltd.

Textiles

Albany International Canada Inc.
BASF Canada Inc.
Barrday Inc.
Bell Tootal Inc.
Bermatex Inc.
Cambridge Towel Corp.
Canada Cordage Inc.
Comdye Inc.
Consoltex Inc.
Crossley Karastan Carpet Mills Ltd.
J. L. de Ball Canada Inc.
Dominion Textile Ltd.
Drytex, Division of JWI Ltd.
Dura Undercushion Ltd.
Harding Carpets Inc.
Huntingdon Mills Ltd.
Huyck Canada Ltd.
Interface Flooring Systems Inc.
LaGran Canada Inc.
Niagara Lockport Quebec Industries Inc.
Nova Scotia Textiles Ltd.
Ozite Canada (1981) Inc.
Patons & Baldwins Canada Inc.
Peeters Carpets Ltd.
Poli-Twine Corp.
Polymer International, a Division of Intertape Polymer Inc.
Rayonese Textile Inc.
Rubyco Inc.
Rumpel Felt Co. Ltd. (The)
Satexil Inc. Division Texgram
Sauquoit Industries Ltd.
Spinright Yarns & Dyers Ltd.
Stewart Group Ltd.(The)
Tapis Coronet Inc.
Tapis Peerless Ltée (Plant No. 3)
Tapis Venture Ltée
Tissus Hafner du Canada Ltée
Tricots Canada U.S. Inc.
Tricots Duval & Raymond Ltée

Transportation (Mfg.)

Canadian Maritime Industries Assoc.

MIL Davie Inc.
Port Arthur Shipbuilding
Stone Marine Canada Limited
Vancouver Shipyards

Canadian Truck and Trailer Mfg. Assoc.

Accuride Canada Inc.

Allied Boating Assoc.

Lund-Larson Boats Canada, Ltd.

Motor Vehicle Manufacturers' Assoc.

Chrysler Canada Ltd.
Ford Motor Company of Canada Limited
General Motors of Canada Limited

Aerospace Industries Assoc. of Canada

Aero Machining Ltd.
Airtech Canada
Allied Signal Aerospace Canada, Garrett Canada
Bell Helicopter, A div. of Textron Canada Ltd.
Boeing Canada Technology Ltd.
Bombardier Inc. Canadair Div.
CAE Electronique Ltée
Canadian Marconi Company
Chicopee Manufacturing Limited
Donlee Precision
Ebco Industries Ltd.
GE Canada Inc.
Litton Systems Canada Limited
McDonco Machine Limited
McDonnell Douglas Canada Ltd.
Oerlikon Aerospace
Pratt & Whitney
Raytheon Canada Limited
Rolls-Royce (Canada) Ltd.
Spar Aerospace Limited
Walbar Canada Inc.

Automotive Parts Manufacturers' Assoc.

BF Goodrich Canada Ltd.
A. Berger Precision Ltd.
Budd Canada Inc.
Camoplast Inc.
Canada Forgings Inc.
Canadian Autoparts Toyota Inc.
Champion Spark Plugs Ltd.
Cochrane Tool & Design Limited
Daymond Aluminum, A div. of Daymonex Limited
Degussa Canada Ltd.
Dominion Controls Company
Eaton Yale Ltd.
Fabricated Steel Products.
FAG Bearings Limited
Fahramet-Kubota Metal Corp.
GE Canada Lighting
Gencorp Automotive
Goodyear Canada Inc.
Hayes-Dana Inc.
Hyundai Auto Canada Inc.
ICM/Krebsoge
Johnson Controls Inc.
Kelsey-Hayes Canada Inc.
Numet Engineering Ltd.
Pebra Inc.
Quality Safety Systems Company
Rimply Mfg., A Division of Decoma Plastics
Rockwell International of Canada Ltd.
Rustshield Plating Ltd.
SKD Company
Slater Steels Corporation
Tesma International Inc.
Thyssen Marathon Canada Inc.
Torrington, Div. Ingersoll-Rand Canada Inc.
TRW Canada Inc.

Wood Products

Atco Lumber Ltd.
Canadian Forest Products Ltd.
CIPA Lumber Co. Ltd.
Delta Cedar Products Ltd.
Doman Forest Products Ltd.
Evans Products Co. Ltd.
Federated Co-Operatives Ltd.
Fletcher Challenge Canada Ltd.
Gorman Bros. Lumber Ltd.
Lakeland Mills Ltd.
MacMillan Bloedel Ltd.
Nechako Lumber Co. Ltd.
Northwood Pulp & Timber Ltd.
The Pas Lumber Company Ltd.
Primex Forest Products Ltd.
Repap Smithers Inc.
Riverside Forest Products Ltd.
Slocan Forest Products Ltd.
Stuart Lake Lumber Co. Ltd.
Weldwood of Canada Limited
Zeidler Forest Industries Ltd.

Appendix A

Prefix	Multiple	Symbol
kilo	10^3	k
mega	10^6	M
giga	10^9	G
tera	10^{12}	T
peta	10^{15}	P
exa	10^{18}	E

Energy	Metric	Imperial
Electricity – net	3.6 MJ/kWh	3,414 BTU/kWh
– gross	10.551 MJ/kWh	10,000 BTU/kWh
Natural Gas	37.2 MJ/m^3	1.0 x 10^6 BTU/MCF
Propane	26.6 MJ/litre	0.1145 x 10^6 BTU/IG
Crude Oil (#6)	38.5 MJ/litre	5.8 x 10^6 BTU/bbl
Distillate Oil(#2)	39.0 MJ/litre	0.168 x 10^6 BTU/IG
Residual Oil (#5)	42.3 MJ/litre	0.182 x 10^6 BTU/IG
Coal – Bituminous	32.1 GJ/tonne	27.6 x 10^6 BTU/ton
– Subbituminous	22.1 GJ/tonne	19.0 x 10^6 BTU/ton
– Metallurgical	29.0 GJ/tonne	25.0 x 10^6 BTU/ton
Coke – Petroleum (Raw)	23.3 GJ/tonne	20.0 x 10^6 BTU/ton
Gasoline	36.2 MJ/litre	0.156 x 10^6 BTU/IG
Diesel Fuel	39.9 MJ/litre	0.172 x 10^6 BTU/IG
Kerosene	38.8 MJ/litre	0.167 x 10^6 BTU/IG
Liquid Propane Gas (LPG)	27.1 MJ/litre	0.117 x 10^6 BTU/IG

To Convert from	to	Multiply by
Cubic Feet	Cubic Metres	0.028
Cubic Feet	Gallons (Imperial)	6.229
Cubic Feet	Litres	28.316
Barrel (Oil)	Cubic Metres	0.159
Barrel (Oil)	Gallons (Imperial)	34.973
Gallon (Imperial)	Litres	4.546
Gallon (U.S.)	Gallons (Imperial)	0.8327
Short ton	Pounds	2000
Short ton	Tonnes	0.9072
Tonne	Short tons	1.102
Long ton	Pounds	2240
Long ton	Tonnes	1.016
Kilogram	Pounds	2.205
BTU	Joules	1055.1
Kilojoule	BTU	0.948
Gigajoule	Barrels Oil Equiv.	0.164

Appendix B

Emission factors - Industrial Fuels

kilograms per Terajoule

Fuel	NOx	VOCs	SO_2	CO_2
Coke	-	-	-	106,330
Coal				
Bituminous	218.069	1.246	1,457.944	86,720
Lignite	0	0	1,628.959	101,680
LFO	61.538	0.615	113.333	73,110
HFO	169.231	3.077	853.428	71,540
Kerosene	61.538	0.615	30.670	67,650
Diesel Oil	57.644	125.313	-	70,690
Nat Gas	60.215	1.183	0.258	49,680
LPG	56.458	1.107	0.148	59,840
Pulp Liquor	68.786	64.487	146.1	70,629
Pet. Ref. Gas	-	-	-	12,080
Fuel Wood	-	-	-	81,470

Sources: Environment Canada Report EPS 5/AP/2, May 1990

Proceedings from Energy Efficiency, Energy Choices - Lifestyles Work Group, EMR, March1990.

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